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ON THE INCIDENCE OF THE SACRALIZED TRANSVERSE PROCESS AND ITS SIGNIFICANCE¹

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INTEREST in the sacralization of the transverse process of the fifth lumbar vertebra has manifested itself in a very extensive list of publications, the greater part being by French and Italian

ports that he encountered 10 cases in the course of a year. In this country, Goldthwait (4) and Adams (5) have written on sacralization. Moore (6), Bauman (7) and Rugh (8) have dealt with the operative



Fig. 1. Matsumoto's sacrum of great antiquity. Contrast with Fig. 8, anatomical specimen No. 17.

writers. It is evident that the problem of the sacralized transverse process has, in France, attracted a degree of attention seemingly out of proportion to its medical importance. One writer, Léri (1), caustically states that it has become the "mode," which is reminiscent of our "sacro-iliac strain" of a few years ago. Painful sacralization has been designated "Bertolotti's syndrome" in Italy, following the publications on that subject of the writer of that name (2). In England, Holland (3) has published an excellent paper on this subject and states that there were no other British titles. Among other things, he re-

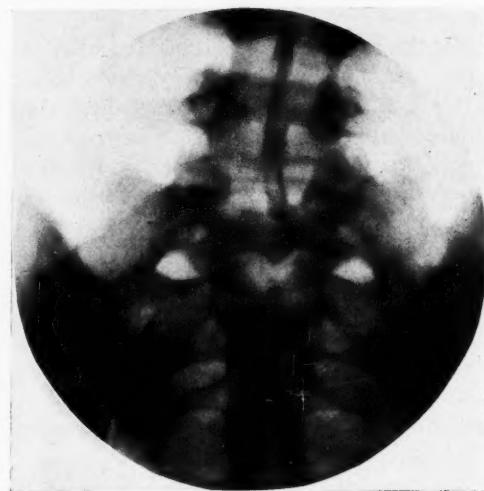


Fig. 2. Patient thought to have chronic appendicitis. Tenderness to palpation equal on two sides of sacralized process. Vertebral formula, T-11, L-6, S-5.

sults. Richard (9) published a splendid article on the diagnostic aspects in 1919 and no later writer has improved on his work. He found bone anomalies present in 90 per cent of patients with painful back, and of this number 60 per cent showed

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anomalies of the transverse process. Sutherland (10), in a paper on anomalies of the spine, reported 527 sacralizations in

rial an incidence of 2 per cent in Europeans and of 40 per cent in lower races, the anomaly being extremely common in anthropoid

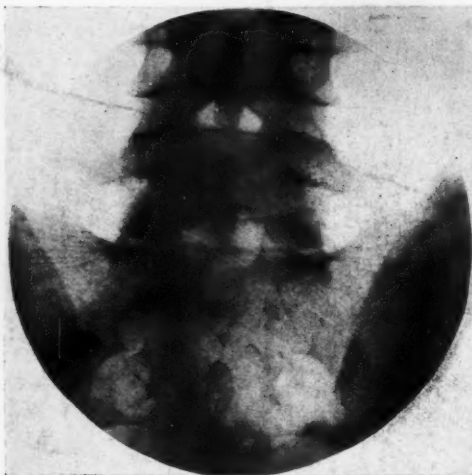


Fig. 3. Normal spine on the left, showing fifth lumbar vertebra; thighs flexed, lumbar region flat. On the right, thighs extended, exaggeration of forward lumbar curve. Note difference in vertical dimensions of the transverse processes in the two positions, and relationship to the sacral ala.

12,000 radiographs, an incidence of 4.5 per cent, but did not supply clinical data.

Sacralization has long attracted the attention of the anatomist and the morphologist. As Quain says, the subject is of interest not only in regard to the spine, but in relation to the whole problem of variations in general (11). Neither should its anthropological interest be overlooked. But its medical importance until recent times has been restricted to pelvic deformities and their obstetrical bearing—the high or low assimilation pelvis of the obstetrician (12).

The anomaly cannot be discovered except by radiography and through radiography attention has been drawn to it because the anomaly is so frequent and its association with painful symptoms in the back so close, that the question of its incidence and significance deserves consideration.

Albanese (13), after study of a very large amount of anatomical material, concludes that sacralization is atavistic. He found it in 4 per cent of Europeans and in 41.6 per cent of inferior races. Mauclaire and Flipo (14) found in anatomical mate-

apes. They quote Rossi as discovering the condition seven times in four hundred radiographs, and conclude that it is rever-



Fig. 4. X-ray appearance of normal spine.

sive. In this connection the sacrum discovered by Matsumoto, illustrated by Boule (15), claims our attention. It is a fossil

examination of that region of the spine. In the writer's experience, for instance, there is a high incidence of sacralization

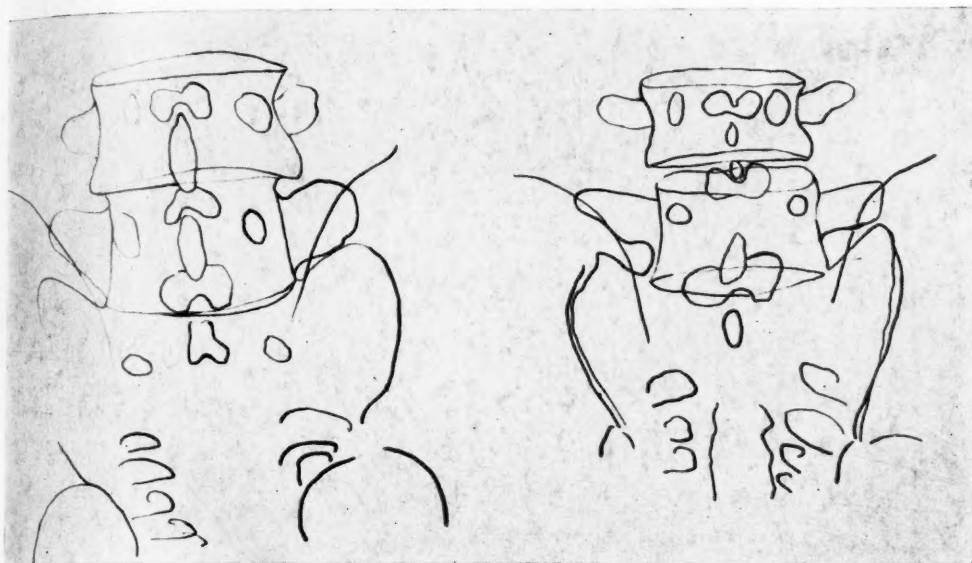


Fig. 5. Tracings of lumbar spines. On the left, in creased bulk of transverse process; on the right, increase in length.

sacrum of great antiquity, showing a tendency to lumbarization of the first sacral vertebra (Fig. 1). Bardeen (16) found 4.4 per cent of sacralizations against 2.7 per cent of lumbarizations. Thompson (17) found 10 per cent of variation in the fifth lumbar vertebra in 79 anatomical subjects. Willis (18), in 748 skeletons, reports a pre-sacral numerical stability of 95.8 per cent, with a tendency of .66 per cent towards decrease and of 3.47 per cent towards increase. He found evidence of sacralization of the twenty-fourth vertebra in 35, or 4.68 per cent of subjects, while partial sacralization was found in 15, or 2 per cent. In only 5 out of 748 spines was there evidence of actual bone contact between transverse process and sacrum, a statement which is in strong contrast with the writer's data.

Lumbo-sacral variation has an interest quite aside from its anatomical and morphological aspects. This is its frequent discovery in the course of the radiographic

in cases sent in for genito-urinary examination. This is partly to be explained by the fact that this region of the spine appears on X-ray examinations of the urinary tract, in which case the finding is entirely fortuitous. However, there have been enough examples of fracture or disease of the lumbar spine sent in to the laboratory for investigation of the urinary tract to convince him that the back symptoms in either class of cases are either not well understood or are so nearly alike as not to allow of differentiation. The writer does not believe that sacralization could play any part in the production of genito-urinary disease, but, on the contrary, genito-urinary disease could well exaggerate the symptoms of spinal disturbance. The occurrence of sacralizations in genito-urinary cases in the series reported is too high and the number of those with equivocal findings too great to permit of any other conclusion than that many cases of sacralization with painful

back symptoms are being considered as genito-urinary cases.

We have some reason to believe that a similar situation exists in regard to the ali-

tence of pain and a sacralized process alone do not warrant resection.

Sacralization of the transverse process of the fifth lumbar vertebra is a congenital

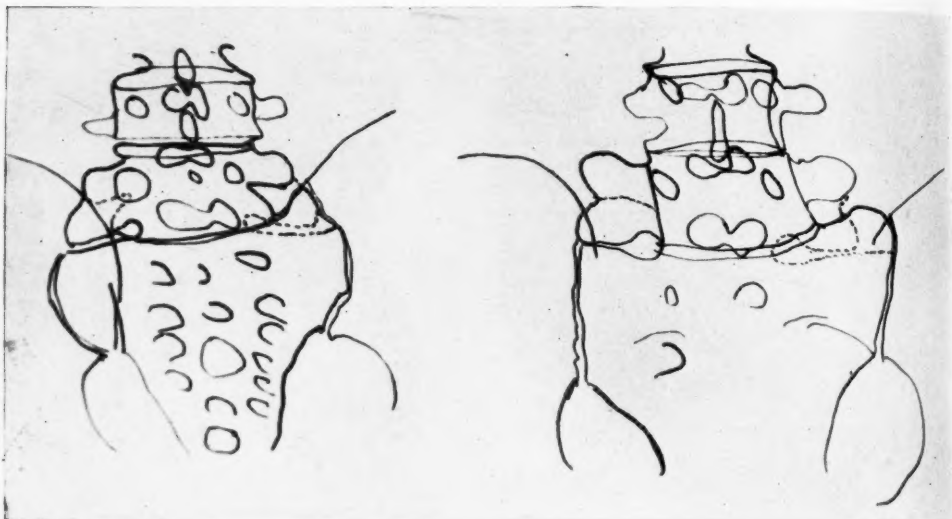


Fig. 6. Tracings of lumbar spines. On the left, sacralization; on the right, lumbarization. Unilateral in each case. Dotted line reconstructs the points mentioned.

mentary tract in its lower portions, and the writer will give an illustration of this point (Fig. 2). Some of these cases go the rounds with the label of neurasthenia, and others, with nerve disturbance in the lower limbs, are thought to suffer from cord disease.

Individuals with this anomaly who have suffered injury to the back form a group whose symptoms most obstinately persist, as compared with examples of like injury in the absence of the anomaly. The existence of the sacralization has an important bearing industrially and in relation to personal injury cases, which points will be referred to again.

Another reason for this study lies in the fact that operative intervention is being undertaken on an increasing number of these patients, and, though results are questionable in many instances, operative procedure seems to promise much, provided the cases are properly selected with regard to their individual properties. Mere exis-

anomaly and is, as the term implies, the taking on of sacral characteristics by the process. The term should, therefore, be restricted to designate only such deviation. Simple increase in length, bulk and the approximation of the shadows of the transverse process and those of the sacral alæ do not constitute sacralization. Radiographically the last may be produced by the projection of the images of the transverse processes by the angle of incidence of the rays (Fig. 3), due to the latter not being perpendicular to the anterior surface of the fifth lumbar vertebra. It is also possible that, due to the position of the fifth lumbar vertebra upon the sacrum, the angle of the former on the latter does not permit a perpendicular incidence of the ray on the anterior aspect of the vertebra in question. The result in either case is the production of an apparent impingement of the process on the sacrum.

Simple increase in length should not be confused with sacralization, as any degree

of the latter can be placed in the category (which is great) of normal variation. However, radiologically, at any rate, there is revealed what may be considered a normal

process is simply that of a process large in all dimensions (Fig. 5).

It must be clearly borne in mind that distortion figures extensively in the produc-

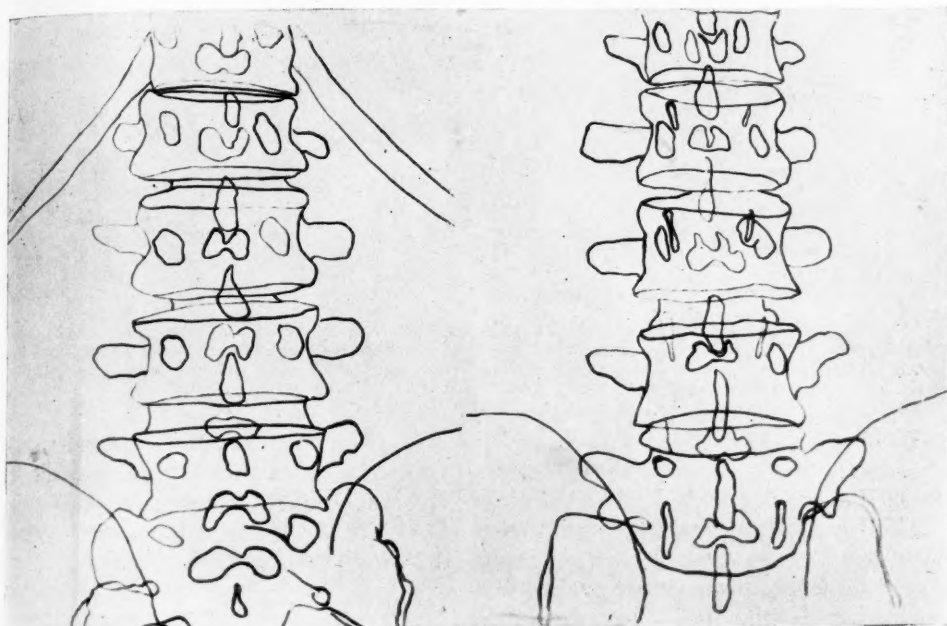


Fig. 7. Tracings of lumbar spines. On the left, giant form sacralization; on the right, rudimentary type.

lumbar and sacral spine (Fig. 4). Excessive length was not notable in the writer's

tion of variations in the vertical dimensions of the transverse process. Examination of a series of fifth lumbar vertebrae in the



Fig. 8. Anatomical specimen No. 17, white, male, aged 31. Lumbarization of first sacral vertebra. Vertebral formula, C-7, T-12, L-5, S-5.

material. Symmetrical increase in bulk does not imply a sacral transformation, i.e., where the appearance of the transverse

dried state shows a constancy of physical characters that would never be anticipated from radiographs.



Fig. 9. Anatomical specimen No. 18, white, male, aged 63. Left sacralization of fifth lumbar vertebra. Vertebral formula, C-7, T-12, L-5, S-5. *A*, Anterior aspect; *B*, Posterior aspect; *C*, above, Inferior aspect of fifth lumbar, and below, Superior aspect of first sacral vertebra. Note wide articulating space at point of sacralization. Bones have been sawn vertically.

With regard to the foregoing definition of sacralization, its presence should be conditioned radiographically by the following:

1. The upper and a varying proportion of the outer border of the sacralized process should have the form, outline and dimensions approximating those of a normal fifth process; in unilateral cases this is readily seen.

2. The sacralized process must be manifest as an increase in size which originates from its inferior surface.

3. This mass of bone must extend downward and outward.

4. A certain small portion of the root of the process which shows no enlargement must remain, equaling the dimension of the canal for the fifth lumbar nerve.



Fig. 10. Anatomical specimen No. 34, white, male, aged 35. Left sacralization of fifth lumbar vertebra. Vertebral formula, C-7, T-12, L-5, S-5. *A*, Anterior aspect; *B*, Posterior aspect; *C*, above, Inferior aspect of fifth lumbar, and below, Superior aspect of first sacral. Note rudimentary articulating processes on side of sacralization.

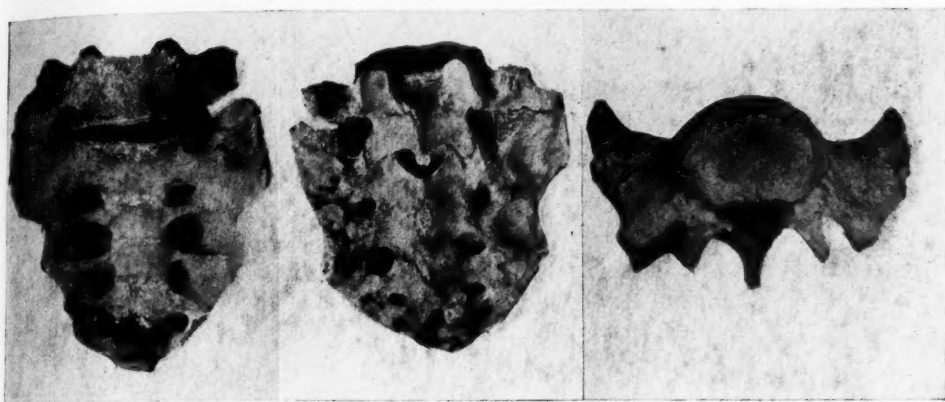


Fig. 11. Anatomical specimen No. 52, white, male, aged 47. Right sacralization of fifth lumbar vertebra. Vertebral formula, C-7, T-12, L-5, S-5. *A*, Anterior aspect; *B*, Posterior aspect; *C*, Superior surface of fifth lumbar vertebra. Note bony ankylosis with eburnated bone at site of sacralization.

The foregoing description and conditions are set forth because the writer holds that many of the illustrations found in the literature are not sacralizations at all. Furthermore, examination of anatomical specimens convinces him that the preceding conditions constitute radiographically the correct criteria for establishing the existence of sacralization. The failure to draw clear-cut distinctions between real and apparent sacralizations has much to do in explaining the divergence of views as to its clinical significance.

The presence of true sacralization can, the writer believes, be determined by the inherent radiographic character of the transverse process without recourse to enumeration of the vertebrae. However, there is another anatomical variation of the region to which Léri (1) particularly has called attention, i.e., the lumbarization of the first sacral vertebra. This is the reverse of sacralization, and the writer would condition its existence on the following: The lumbarized process should present an upper and varying portion of outer border, having

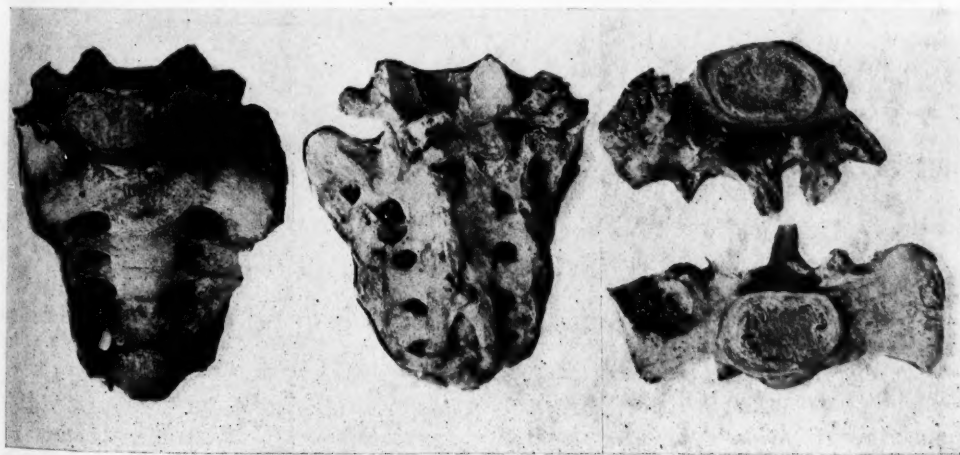


Fig. 12. Anatomical specimen No. 109, age, sex, race, unknown. Right sacralization of fifth lumbar vertebra. Vertebral formula, C-7, T-11, L-5, S-5. *A*, Anterior aspect; *B*, Posterior aspect; *C*, above, Inferior aspect of fifth lumbar vertebra, and below, Superior aspect of first sacral. Note hypertrophic change about margin of sacralization, and rudimentary articulating processes on side of sacralization.

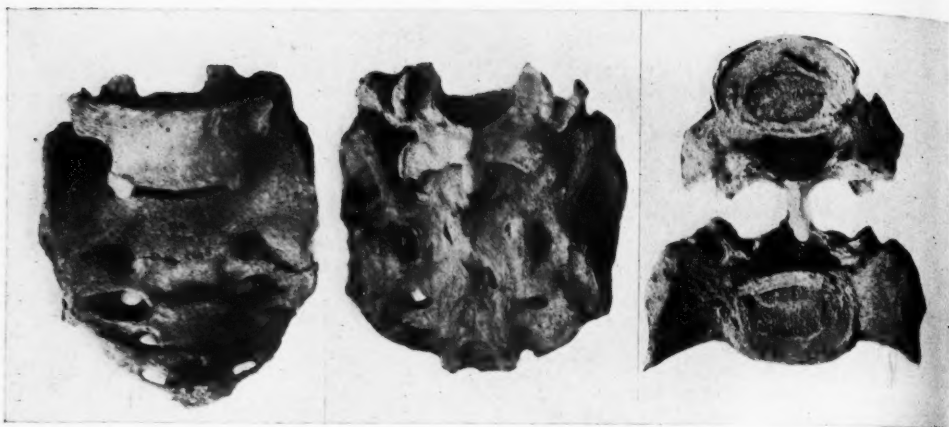


Fig. 13. Anatomical specimen No. 110, age, sex, race, unknown. Left sacralization of sixth lumbar vertebra. Vertebral formula, C-7, T-12, L-6, S-5. A, Anterior aspect; B, Posterior aspect; C, *above*, Inferior aspect of sixth lumbar vertebra, and *below*, Superior aspect of first sacral.

the outline and dimensions comparable to a fifth transverse process. At the same time, the massive bulk of the inferior portion should approach in appearance a sacral ala (Figs. 6 and 7).

With the material on which this paper is based, an attempt was made to differen-

to the accurate determination whether such an anomaly is one of sacralization or lumbarization, the vertebral formula must be known and this cannot be determined by radiography. The limitation of radiography for this determination should be clearly understood. In a manner of speak-

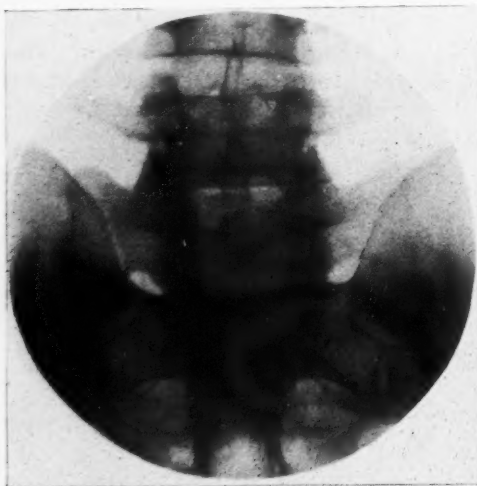


Fig. 14. Male lumbar spine, showing small, individual bone in relation with a sacralized transverse process.

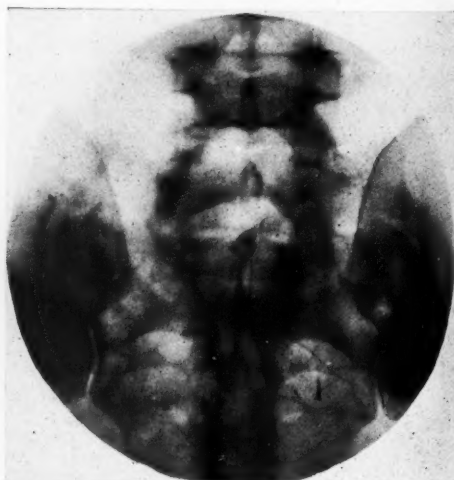


Fig. 15. Same as Fig. 14.

tiate between lumbarization and sacralization, both objectively and in the clinical analysis of the cases, but it was found impossible to do so, and, indeed, for practical purposes it is unnecessary. As a requisite

ing, radiography is an indirect method of inspection and this is further limited in the case of the fifth lumbar vertebra to its ventral aspect. This method gives very satisfactory information regarding both the

body and its transverse processes. From this certain other facts may be deduced, but there is little information to be had in re-

which there is a striking lack of objective findings. It is just here that we welcome the discovery of sacralized transverse proc-

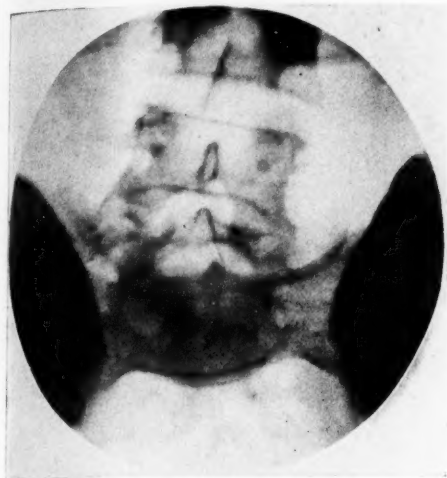


Fig. 16. Same as Fig. 14.

gard to the superior and inferior surfaces and none at all concerning the posterior, save the tip of the spinous process.

Patients complaining of symptoms referable to the lower back are extremely numerous. Of such symptoms, pain is the one most commonly present. It is very variable in all its features and the disability it entails. It may be trifling in character or may confine the patient to bed. Between these limits all degrees are found. The great frequency of the morbid conditions attributable to the lower spine can be found in the fact that 9 per cent of the patients coming to the Washington University X-ray Department are sent for examination of the lower spine. This figure is probably the same in any other well-balanced general clinic and in all likelihood holds for general roentgenological practice.

Excluding fracture, tumor, destructive disease and arthritis there remains a substantial number of these patients in whom the examination is barren of results. There are the cases bearing the clinical designation of "sacro-iliac strain," "low back pain," "sacro-iliac subluxation," etc., in

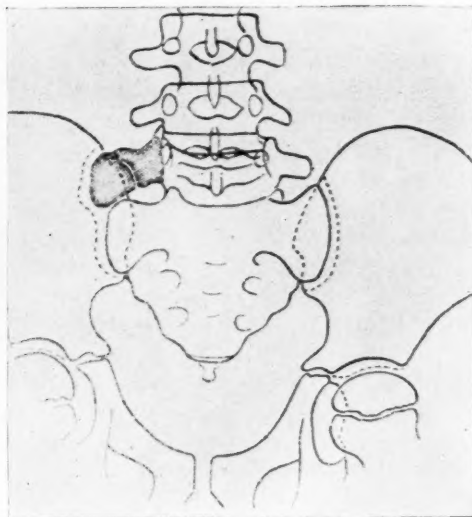


Fig. 17. Reproduced from a publication by Ledoux and Caillods in the *Presse Médicale*, 1921, vol. XXIX, showing the same ossicle as in the foregoing three figures.

esses or a spina bifida occulta, for they present tangible findings by which the pa-

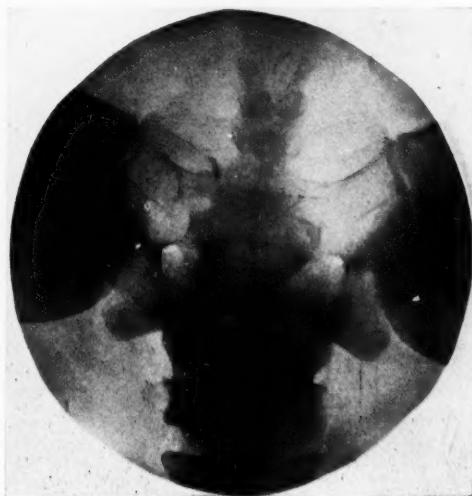


Fig. 18. Female lumbar spine, showing bilateral sacralization of the fifth lumbar vertebra.

tients' symptoms *might* be explained. However, to link up these variations and the

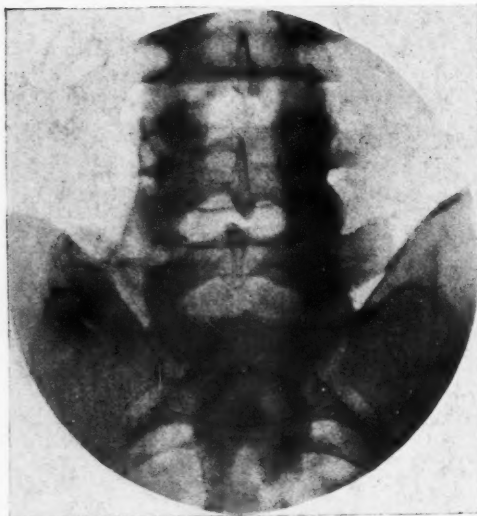


Fig. 19. Male lumbar spine, showing unilateral sacralization of the fifth lumbar vertebra.

symptoms as cause and effect is most difficult.

The origin of pain in the lower lumbar region is difficult to discover. In the past, in this country at least, it has been exten-



Fig. 20. Female lumbar spine, showing bilateral sacralization of the fifth lumbar vertebra with variation on the two sides.

sively attributed to disturbances in the sacro-iliac joints. These last may be and probably are subject to any disease condition that might affect other joints. But why

such large and powerfully supported joints should give way before strain has never been clear to the writer. Strains transmitted from the trunk to the lower limbs and in the reverse direction must be transmitted



Fig. 21. Example of sacralization in the lumbar spine of a female child under 15.

through the lumbo-sacral joint, made up of the disk between the fifth lumbar and sacrum and their articulating processes. This joint relative to the sacro-iliac is both small and poorly supported by ligaments and almost not at all by muscles. Hence it seems that strain here would be common and at the sacro-iliac joints rare; especially would this appear to be the case for twisting strains. Sacralization or lumbarization of transverse processes would appear because of mechanical reasons: through limitation of movement, by acting as a fulcrum (Goldthwait); by producing rigidity on one side, serve to strain their joint or the one next above, more than would be the case were the anomaly absent. In consequence, it seems reasonable to suppose that a lumbo-sacral joint in the presence of a sacralized transverse process is an abnormal joint, and if symptoms of joint strain are present it is one of the joints above, not the sacro-iliac, that is the offender.

The series of cases of sacralization which the writer has assembled numbers 117 and

has been found in the collection of radiographs of the Washington University X-ray Department, extending back for thirteen years. As all the X-ray negatives of that period have been preserved, it is possible

cralizaciones have been found in the last year as attention has been paid to this anomaly; in the past doubtless many sacralizations were overlooked. The true percentage is probably nearer 6 than 2.

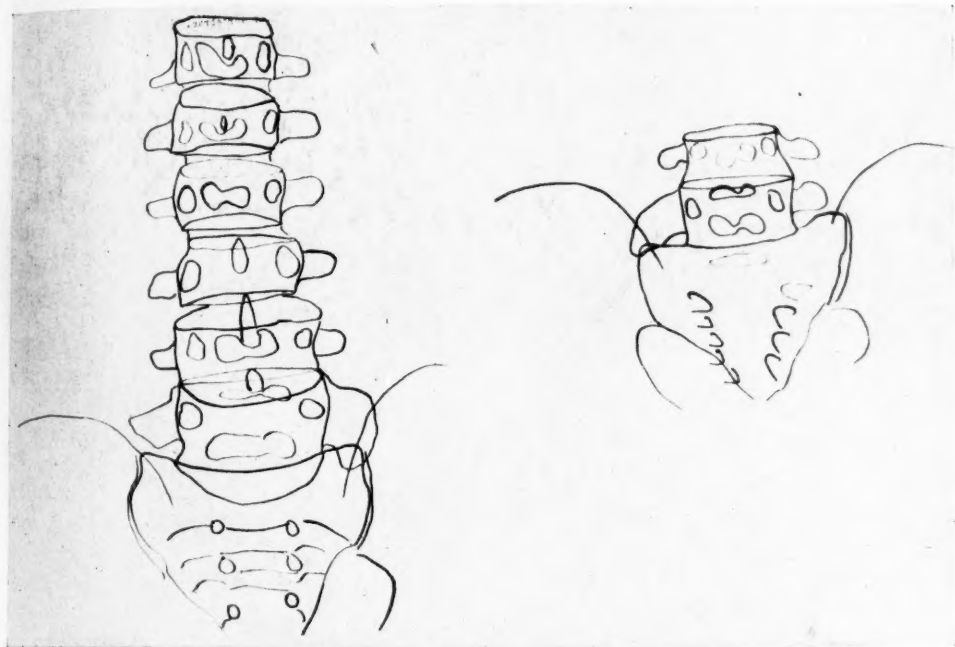


Fig. 22. Tracings of the lumbar spines of two children under 15. On the left, an example of lumbarization of the first sacral vertebra, and on the right, sacralization of the fifth lumbar vertebra.

to determine the incidence with fair accuracy. These 117 cases were found in 3,640 plates of the lumbo-sacral region, which gives a percentage of occurrence of 3.2 as compared with 4 per cent reported by Albanese. There are several sources of error in these figures, such as duplication of names or negatives; however, these should balance themselves in such a long series.

As a check of the above figures, 318 consecutive radiographs showing the lumbo-sacral spine were examined and among this number were 20 sacralizations, a percentage of 6 plus. Over the same period 15 sacralizations were recorded in plates of the urinary tract, but these are to be excluded from the figures of general incidence, as the spines shown on such plates are not recorded as plates of the spine. More sa-

In a further effort to discover the true incidence, I was enabled, by the kindness of Professor R. J. Terry, to examine the material in the Department of Anatomy. This consisted of 117 skeletons, 92 of which were complete as to the spine; the remainder lacking a part or parts are excluded. In the series examined there were 6 examples of sacralization or lumbarization, a percentage of 6+, which presents a gratifying confirmation of the average plate percentage. (Figs. 8 to 13, inclusive.)

These, in contrast with Willis' findings, showed bony contact between ala and process in 7 examples. Not only so, but the points of contact were in some instances covered with compact bone such as would be found beneath articular cartilage. Where this last is lacking the appearance

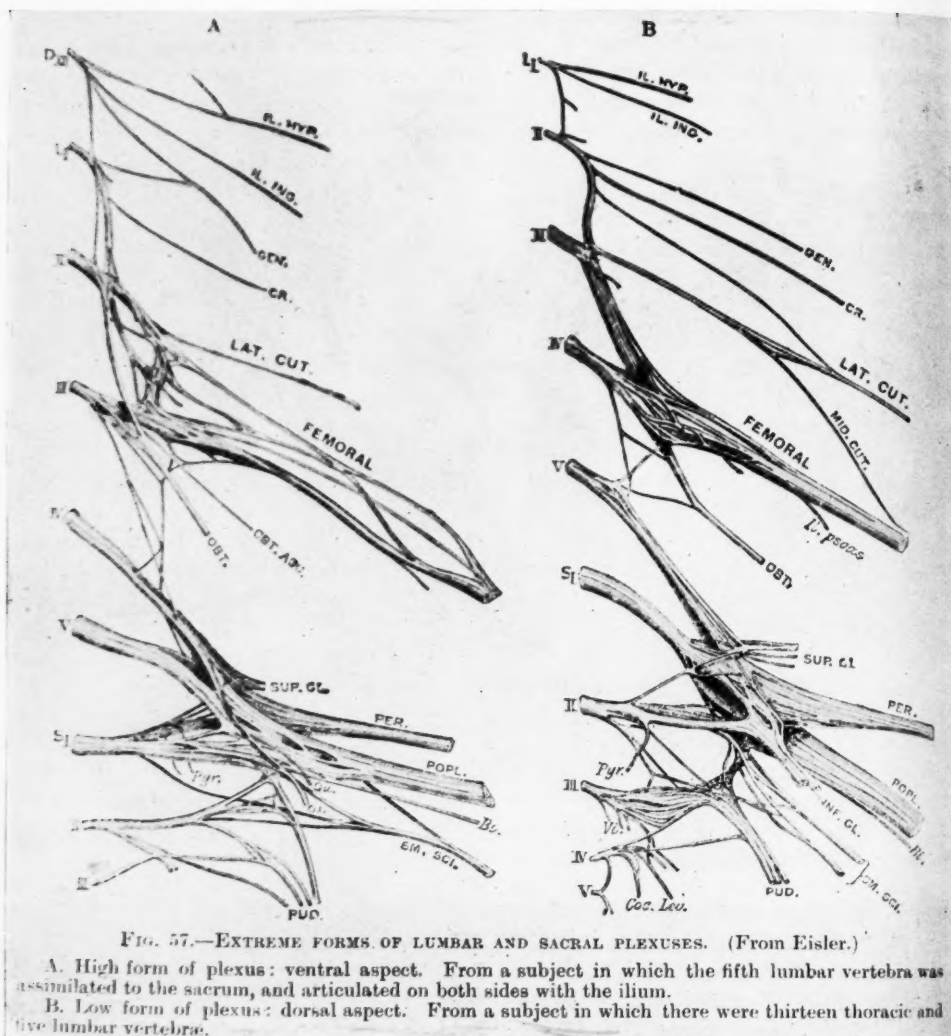


FIG. 57.—EXTREME FORMS OF LUMBAR AND SACRAL PLEXUSES. (From Eisler.)

A. High form of plexus: ventral aspect. From a subject in which the fifth lumbar vertebra was assimilated to the sacrum, and articulated on both sides with the ilium.

B. Low form of plexus: dorsal aspect. From a subject in which there were thirteen thoracic and five lumbar vertebrae.

Fig. 23. Reproduced from an illustration in *Quain's Anatomy*, showing the variation of soft structures accompanying the variation of bone segmentation at the lumbo-sacral junction.

suggests that it has disappeared as a result of destructive arthritis. One (No. 52) showed a bony ankylosis which held the segments firmly together, the junction being of eburnated bone.

Many writers have classified sacralization into types, anatomical or clinical. Richard (9) classified them radiographically, but it seems that his Groups I and II are not properly sacralizations for the reasons advanced above. Only his Groups III

and IV meet these requirements. Ledouble (19) observes that anatomists have classified the sacralized processes into nine or ten types, but reduces these to five. He states that there are all gradations, from rudimentary type to the formation of a complete sacral vertebra. Mauclaure and Flipo (14) form a clinical classification of five types based on that of Ledouble. Their Type I appears to the writer as not being a sacralization, but one within the normal

limit of variation; in other words, it is a large transverse process, not having the appearance of a sacral wing.

As a means of more convenient study, the writer traced the outline of the bones in his radiographs and then endeavored to classify the different types. The variability, however, was too great to allow of this with any satisfaction. Two types (Fig. 7), the rudimentary, with a small downward projection of bone about at the junction of the inner and middle thirds of the transverse processes, and the giant type in which there is a large bulk of bone joining the sacrum, ilium or both, may be distinguished. Complete sacralization is impossible of radiographic determination. The rudimentary type is included as sacralization solely because it was found fairly constantly on the side opposite a unilateral sacralization; taken alone it does not constitute a sacralization. Four such rudimentary cases are included, one an adventitious case, one history unknown, one with six rib-free pre-sacral vertebrae, and one with a history of lumbar pain. Between the rudimentary and the giant types all gradations are to be found.

An unusual finding has been the discovery, in three instances, of a small individual bone in relation with a sacralized transverse process (Figs. 14, 15, 16). Figure 17 is reproduced from a publication of Ledoux and Caillods (20) in *Presse Médicale*, showing a separate ossicle seemingly joined by epiphyseal cartilage to the transverse process. These authors consider this the ossific center for the lateral sacral mass, which is not united.

As to symmetry, the sacralization may be bilateral (Fig. 18), unilateral (Fig. 19), and where it exists bilaterally there may be wide variation on the two sides (Fig. 20).

The number of lumbar vertebrae could not be determined in 33.9 per cent of cases; in 44 per cent there were five and in 20 per cent six rib-free pre-sacra. Twenty-three per cent of cases were right sacralizations and 40 were left; the bilateral sacralizations appeared in 34 per cent.

The anomaly was discovered adventitiously in 32 per cent of cases, whereas the patients had back or nerve symptoms in 61 per cent of all cases studied. No conclusion could be drawn on racial lines and the sexes were about equally divided. Only 8 per cent were in children under 15 years of age (Figs. 21 and 22); these are placed in the fortuitous class with one exception—a child sent in following a fall and diagnosed sacro-iliac strain.

Fifty-nine per cent of all cases followed occupations that subjected them to back strain and 26.8 per cent had suffered actual injury. Two of these last were in personal injury suits, as was another (not included in this report) who won his verdict. This brings in the medico-legal feature of the condition. Turini (21) directs attention to this anomaly from the standpoint of military service and social insurance and Imbert and Catholorda (22) query if a workman with a sacralization, who is injured, is to receive compensation.

Back pain was the chief complaint of 61 per cent of the patients radiographed; 56.8 per cent of the total number of cases had lumbar pain, while 35 per cent had referred pains and 28 per cent tenderness on palpation.

The symptoms found in sacralization fall into two groups: nerve and joint. There are also combinations of the two. In no case can sacralization be diagnosed on symptoms where existent, or on physical examination because of the protean nature of the manifestations. This inconstancy is possibly to be explained by the anatomical variation of the sacralization. That sacralization contributes to strain of the sacro-iliac articulation is unlikely, as has already been pointed out.

The theory that the pain is due to the impingement of bony parts or the compression of soft structures between bony parts seems not to have a leg to stand on. As to the last, there are no soft tissues except ligament and periosteum to be pinched between bony points. As to painful bony impingement, its existence seems impossible when

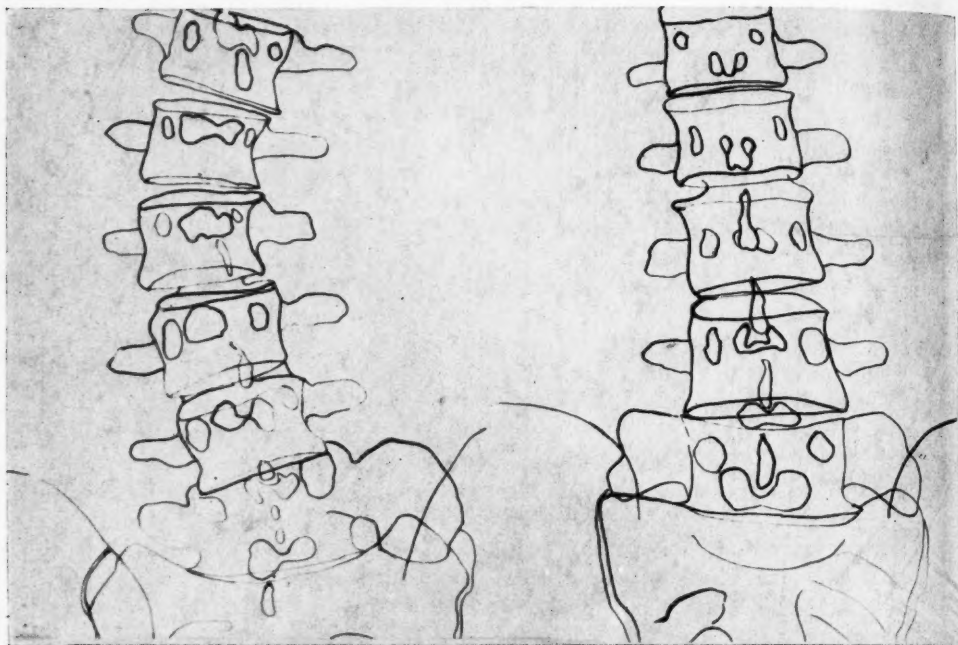


Fig. 24. Tracings of two sacralized lumbar vertebrae; on the right, example of giant, unilateral sacralization with extreme scoliosis, and on the left, giant bilateral sacralization with practically no scoliosis.

one recalls the accommodation presented in congenital dislocation of the hip.

Both Goldthwait and Richard point out inflammation in abnormal joints and bursæ as sources of pain. Several of the writer's series showed undoubted evidence of the existence of inflammation in abnormal joints, evidence of which is also to be seen in the anatomical specimens. Being abnormal, it is reasonable to assume that such a joint would be particularly subject to inflammatory phenomena.

As to nerve symptoms, these are as uncertain as those of the joint. Most frequently sensory, they may be motor, and their intensity is most variable. Many writers consider them due to compression of the fifth lumbar nerve through narrowing of its opening into the spinal canal by encroachment of the transverse process. Anatomical specimens do not confirm this. However, where a joint exists between the sacral ala and the transverse process the outer wall of the canal for the nerve is formed by this joint. Inflammation in the latter could involve the nerve either by com-

pression or by continuity of inflammation, and possibly this explains some of the cases with nerve symptoms.

Everyone who has written on sacralization has dwelt on the bone, joint, bursa variation; a few have suggested the possibility of variation in segmentation, but the present writer has been unable to find any examples of such save a dissection of the lumbar plexus illustrated in *Quain's Anatomy* (Fig. 23). There is nothing to be found on abnormality or aberrance in the ligamentous support which assuredly must take place. Certainly, joint strain cannot be understood until the ligaments in sacralization are known. What is needed to clarify the problem is a series of fresh dissections.

Sacralization is used by several writers to explain the occurrence of scoliosis. It was found generally in slight degree in 3.6 per cent of this series (Fig. 24). Of the type of structural scoliosis, sacralization was found in but one of 39 consecutive cases and in this one it was bilaterally symmetrical.

CONCLUSIONS

1. Sacralization (and lumbarization which cannot be distinguished) are of great anatomical interest. But more important, they are of great clinical significance. They are found in about 6 per cent of all individuals, and in 61 per cent of patients with lumbar symptoms.

2. The condition needs study, clinical and particularly anatomical with attention to the ligaments.

3. Study of these cases has not suggested any new ideas in treatment. It indicates that resection promises a great deal in selected cases.

4. The individual with a sacralization has a liability and should follow an occupation free from the hazard of back strain.

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Three types of renal tumors.—Wheeler reports three cases of renal tumor sufficiently rare to be worthy of record.

The first case was that of an adenomysarcoma (embryoma) in an infant eight months of age. There were no signs or symptoms of any kind except for the presence of a large abdominal tumor arising on the left side. The tumor was removed but promptly returned and the child died within a year. On microscopic examination of the tumor six different tissues were found to enter into its formation; renal, adenomatous, sarcomatous, non-striated muscular, connective and vascular tissue.

In the second case there was a squamous celled carcinoma in a woman 52 years of age. Patient had had symptoms for 12 years. The roentgenograms showed multiple stones in the left kidney—four in the upper and ten in the

lower pole. Accordingly this diagnosis was made and the kidney removed. The pathologists reported malignant tumor superimposed on a calculus pyonephrosis, the latter condition being the etiological factor in the production of the carcinoma.

Case three: Angioma of the kidney. A clergyman, 57 years of age, developed a sudden severe urinary hemorrhage without previous warning or any signs of ill health. The urine passed had the appearance of pure blood. Owing to the severity of the hemorrhage the kidney was removed immediately. The angioma was under the mucous membrane of the pelvis, being made up by a rich arterial plexus of blood vessels.

K. S. DAVIS, M.D.

Some Renal Tumors. Sir William I. de Courcy Wheeler. Surg., Gyn. and Obst., XXXVIII, Feb., 1924, p. 143.

CHRONIC ULCERATIVE COLITIS: ITS CLINICAL AND RADIOLOGICAL ASPECTS¹

By A. H. LOGAN, M.D.

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DISEASES of the colon are now fairly well defined, and in general treatment is standardized. The colon is an organ which can be as easily examined by special and laboratory methods as any in the body. By stool tests, the presence of parasites and the character of the bowel discharges are ascertained, and often determine the disease present. The proctoscope permits direct vision of the rectum, sometimes well up into the sigmoid. The usual examination extends to 20 or 25 cm., and in some patients with air ballooning, 30 to 35 cm. are visible. By this means the character of inflammations and ulcerations can be very definitely determined, as well as the presence of tumors and strictures.

The X-ray of the colon by the aid of the barium enema gives as accurate results as that of any other hollow viscus. It is not of much value in parasitic ulcerations, but in chronic inflammations like tuberculosis and actinomycosis it is of distinct value. The differentiation of these lesions from those in chronic ulcerative colitis is usually easy. Chronic ulcerative colitis, that is, the form of ulceration not known to be due to parasites, bacillus of dysentery, tuberculosis, actinomycosis, syphilis, or cancer, has a distinctive X-ray syndrome of its own, when the lesions extend above the rectum. In the "low type," when the lesions are in the rectum alone, the X-ray is only occasionally of value in showing an indeterminate lesion. Tuberculosis and actinomycosis are more often found in the cecum, while chronic ulcerative colitis, except in very rare cases, starts in the rectum and extends upward. Spasm offers the same difficulty in interpretation as it does in the stomach.

The typical X-ray picture in the chronic stage of the disease shows a narrow, non-

haustrated colon with loss of redundancy, often with narrow areas of either spasm or stricture. In the acute phase, the bowel may empty too quickly to get a filled colon, as in cases of tuberculosis, and may show an irregular fringed outline. In the upper part of the colon where the inflammation is just beginning, irritation may produce many sharp-pointed haustra close together. The X-ray will often demonstrate tumors of the colon long before clinical signs are diagnostic.

In this country very little was known of chronic ulcerative colitis until within the past eight years. Apparently many cases were undiagnosed. In 1918, I reported 117 cases, and have now just completed a study of 283 others, making a total of 400 cases seen in the Mayo Clinic to July, 1923.

Clinically, there are two main types: (1) those in which the disease is chronic, the ulceration either remaining in the rectum and low sigmoid, or extending throughout the entire colon, but in which there seems to be an immunity to any general toxemia, and (2) those in which there is a rapid extension of the disease and but little immunity. In this latter type there is more abdominal distress, often a little fever, and at operation or postmortem marked fatty degeneration of the vital organs is found.

The inflammation starts first in the rectum and extends slowly or rapidly throughout the entire colon. In the acute cases the entire colon may be involved within two or three months; in some of the chronic cases, the disease is confined to the rectum for many years, the X-ray showing a normal colon. In the latter group of cases these diagnoses in the Clinic are made from the clinical symptoms, and the characteristic stool and proctoscopic findings. The acute inflammation at the beginning subsides to a subacute or chronic condition, often accom-

¹Read before the Radiological Society of North America, December 3-7, 1923, Rochester, Minnesota.

panied by superficial or deep ulcers, which are irregular and often conglomerate. At times, linear fissures are produced, and occasionally a membrane forms over the ulcers. In one case, Klebs-Loeffler bacilli were grown from this membrane, but antitoxin only partially removed the membrane and had no effect on the clinical course of the disease. There is a small cell leukocytic reaction in the tissues, causing a thickening in the entire wall of the colon, and a projection into the lumen of the bowel of tissue which appears granular as seen through the proctoscope. Further proliferation in certain areas results in polyp formation, a not uncommon finding in the chronic cases. In the acute inflammatory stage the bowel reacts similarly to external inflammations, is irritable, and resents anything placed against it. Thus when a barium enema is given, there is either rapid emptying of that area, or spasm, as shown either by contraction or many sharply defined haustrations. Later, as chronicity replaces acuteness, the haustra become broader topped with rounded edges, and the irritability being less, spasm and contractions are not so marked. The final stage comes when the bowel wall becomes filled with scar tissue and is greatly thickened, resulting in permanent narrowing with entire loss of haustration, and the development of strictures. The practical difficulty comes because the process is not uniform throughout. There may be an active lesion in one part with one less active in another. In this way, spasm and true stricture may be present in the same patient. We formerly believed that when once the haustra were lost and the bowel wall thickened, a return to normal would be impossible. However, a few of our patients have been cured clinically, and have a normal mucosa, as shown by the proctoscope, and a normal colon, as shown by the X-ray.

The patients complain of a watery diarrhea containing much or little blood, with slight or no abdominal pain or distress. Occasionally there are very sharp and se-

vere cramping pains along the line of the colon, at times requiring morphin for relief. If much blood is lost, anemia is soon manifest, and is usually not relieved until the bleeding has been checked for a long time, as the blood-forming organs are exhausted from constant seepage. If there is much absorption of toxins, a waxy pallor occurs with slight fever and great weakness. Complications are not uncommon, owing to the normal absorptive area being ulcerated, thus allowing toxins and bacteria easy access to the blood stream. Positive blood cultures have been found in several cases. Arthritis is the most common complication, and one wonders if many of the chronic arthritides do not have their foci in the colon. Acute endocarditis, periostitis and erythema nodosum have developed while patients were under observation in the Clinic.

There is a great tendency in the beginning of the disease for remissions to occur without coincident healing of the colon, in this way, resembling cases of gastric and duodenal ulcer. The appetite is good and many patients can see no relation between what they eat and the amount of dysentery. Others have to avoid certain foods on account of immediate increase in the number of stools.

The loss in weight is dependent on the severity of the toxemia and the number of stools. In many cases there is no loss whatever, in others a few pounds are lost during an exacerbation. In the severe cases, the patient has difficulty in retaining food, and that which is eaten passes very quickly through the intestine. This, with the absorption of toxic products, causes extreme loss of weight of from 40 to 80 pounds, reducing the patient to skin and bones. In some of the severe cases in which a Brown ileostomy has been performed, food eaten thirty to forty minutes previously has been discharged from the ileum. This shows an enormous increase in peristalsis, and gives us the reason for weight loss, in that digestion can not be

completed, nor is time allowed for absorption.

TREATMENT

The treatment of chronic ulcerative colitis is very unsatisfactory. No specific is known. One patient may be benefited by one form of treatment, and the same treatment given to the next patient may not be beneficial. Drugs by mouth, enemas and irrigations of the colon, autogenous vaccines, and serums, usually give only temporary relief. Anti-amebic treatment, whether or not amebæ are found, gives about 50 per cent benefit in the majority of cases. Remissions with subsequent relapses are the rule. Cure is the exception. Surgery, by short-circuiting the low ileum through the abdominal wall, acts as does a gastro-enterostomy for a duodenal ulcer.

If a modified Brown ileostomy can be performed before fatty degeneration of the vital organs progresses too far, and before there is inanition and vomiting, it will restore the patient to health and strength. As operation is usually delayed and performed as a last resort, the hospital mortality is high, although the operation is not the direct cause of death in the large majority of cases. Formerly the direct operative mortality was extremely high, but this has been overcome in the past few years. Rarely, a restorative ileosigmoidostomy can be performed after further treatment has cleared all ulcers and inflammation from the rectum.

The morbidity and mortality rates are very high and the disease, when recognized, must be considered as most serious.

Tumors of the renal pelvis.—Tumors of the renal pelvis are usually of epithelial origin and the majority are papillary in type. In the early stages the tumors are small, often multiple, flat or thickly pedunculated and confined to the renal pelvis. They spread rapidly and extensively, involving the calyces and sometimes the ureteral outlet. Obstruction of the ureteral outlet may cause an extensive pressure atrophy of the renal cortex. In the late stages the kidney becomes a distended, sacculated, often infected mass with complete loss of function. The renal pelvis does not offer a free space for growth like that of the urinary bladder. The pelvis is rapidly filled and the papillomatous masses become matted together under tension so that they bulge from the pelvis when the kidney is opened. The ureter is frequently involved in transplants, which are usually found in the normal ureteral constrictions. The individual papillomatous fronds are shorter and broader than similar growths in the bladder, there is a more extensive fusion of adjacent fronds, and atypical cell masses are more often seen.

In the bladder small papillomatous transplants may be found protruding from, or surrounding, the ureteral orifice. At times multiple small transplants are scattered extensively

over the mucosa of the bladder. Histologically the majority of tumors of the renal pelvis, as well as the transplants in the ureter and bladder, are malignant. Clinically the numerous extensions and the local recurrences, make these tumors all malignant. Because of the frequency with which the ureter is involved, and the repeated recurrences after nephrectomy, a complete nephro-ureterectomy is essential to insure even partial success.

Eight papillary tumors of the renal pelvis are reported, all histologically malignant. Three patients died from five to nine months after the operation, one of whom had a transplant to the ureter, and another, a large secondary growth in the bladder. A fourth patient died from uremia four years after nephrectomy. Four patients are still alive, two are still free from recurrence (one, two and one-half years, and the other, four months after the removal of the diseased kidney and ureter). The remaining two patients have had repeated transplants to the bladder, requiring persistent treatment; at the present time both patients are well; one, two years, the other, three years after the first operation.

K. S. DAVIS, M.D.

Papillary Tumors of the Renal Pelvis. A. J. Scholl. *Surg., Gyn. and Obst.*, XXXVIII, Feb., 1924, p. 186.

A DIAGNOSTIC LINE FOR DETERMINING SUBLUXATION OF THE FIFTH LUMBAR VERTEBRA¹

A PRELIMINARY REPORT

By H. J. ULLMANN, M.D., Santa Barbara Cottage Hospital, SANTA BARBARA, CALIFORNIA

CONDITIONS obtaining in the lumbo-sacral region are becoming of more and more importance. Many disabilities, formerly classified as lumbago, back strains, etc., are now being recognized as due to displacements, either permanent or temporary, of the fifth lumbar vertebra from its normal relationship to the sacrum, or to strain primarily due to structural

age norm, a deviation from which constitutes a definite abnormality.

The object of this report is to suggest observation of a large number of symptomless individuals, as well as those with symptoms, to determine how far from a definite sacral base line, here described, the fifth lumbar vertebra may be placed and still be within the norm. If this can be established it is believed that many back strains, which

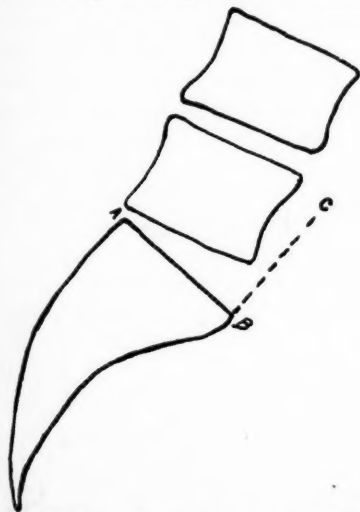


Fig. 1. Normal. A B = upper surface of sacrum. C D is drawn perpendicular to A B at anterior margin of sacral joint surface.

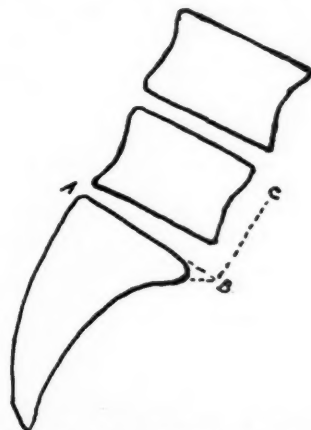


Fig. 2. Normal. Where anterior margin of sacral joint surface is markedly rounded. A B is projected anteriorward to meet a line which is the prolongation of the anterior sacral surface. C D is erected perpendicular to A B at the intersection.

weakness in this region. Displacements of the fifth lumbar, when fairly marked, are easily recognized either by antero-posterior or lateral roentgenograms, but there are numerous instances where distinct subjective symptoms are present but the roentgenologist's report is negative. We are not now in position to say whether certain positions of the lumbo-sacral joint are within normal limits or not. That is, to say that the position seen cannot be responsible for the symptoms, for variation in symptomless individuals is common. It is very necessary, therefore, that we have a fixed aver-

age norm, a deviation from which constitutes a definite abnormality.

The base line suggested by the author is established on a lateral view of the lumbo-sacral region as follows: So far as can be determined at present, it is unimportant whether the tube be centered over the joint or over the third or fourth lumbar vertebra. Neither is it necessary to have a true lateral. Two points are taken on the edge of the sacral articular surface, as far apart as practicable. These points are then connect-

¹Read before the Radiological Society of North America, Rochester, Minnesota, December, 1923.

ed by a straight line which is projected forward until it intersects a line which is either the anterior margin of the sacrum or a prolongation of it.

If the anterior-superior margin of the sacrum is an angle the articular surface line

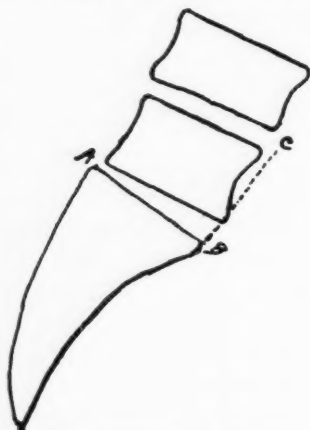


Fig. 3. Anterior displacement.

will intersect the anterior surface line at the point of the angle. If rounded, both lines must be prolonged until they intersect.

A line at 90 degrees to the articular surface line is now erected at this point of intersection. It is believed that this line, perpendicular to the sacral articular surface, should pass well in front of the anterior-inferior margin of the fifth lumbar unless there is an anterior displacement of this vertebra. No symptomless individuals have so far been found where this is not true, and in one instance where the fifth lumbar was just short of touching the line, there were marked symptoms and considerable disability. In a patient of Dr. W. B. Bowman's, with distinct anterior displacement, the line cut through the body of the fifth lumbar.

It is only by observing a large number of symptomless individuals that we may establish the positions that the fifth lumbar vertebra may occupy in relation to this line and still be classed as normal, and it is hoped that others will check up our observations and determine whether this base line is of value or not. We are much in need of a normal standard of limits for this very variable region.

Adhesions about the ascending colon.—

In the majority of the cases reported by the authors there was a recurrence or a non-relief of symptoms following operation for appendicitis. The symptoms were extremely vague and did not offer material aid in the diagnosis of the condition.

Diagnosis was based largely on the roentgenographical findings, which are fairly typical in this type of case.

The authors use the barium meal in preference to the enema.

The roentgenogram reveals a definite disfigurement of the contour of the ascending and transverse colon, owing to the fact that bands of adhesions pass over the colon and produce a par-

tial obstruction at the point of greatest involvement. In most instances there is a ptosis of the transverse colon, it being fixed to the ascending bowel. One most commonly finds the obstruction and kinking due to this fixation, at the hepatic flexure.

In the cases reported by Davison and Boyer, these roentgenographic findings have been verified at operation. Following operation the subjective symptoms are quickly relieved and do not recur.

K. S. DAVIS, M.D.

Adhesions About the Ascending Colon Simulating Chronic Appendicitis. Charles Davison, Marshall Davison, and D. J. Boyer. *Surg., Gyn. and Obst.*, XXXVIII, Feb., 1924, p. 171.

SPONDYLITIS—A SUBMERGED ENTITY IN THE DIAGNOSIS OF OBSCURE CONDITIONS IN THE ABDOMEN¹

By W. H. WALLACE, M.D., F.A.C.P., BROOKLYN, NEW YORK

IN looking over recent textbooks and other current medical literature, one is struck with the paucity of material bearing on spondylitis. It is only when the *Index Medicus* is consulted that one sees the amount of thought and effort that has been expended on the subject.

My specific attention to spondylitis was caused by finding a case of the "Marie-Struempell" type in a patient where all the trouble was referred to the right kidney. This man, a lean individual of thirty-five, had been down to the cystoscopy room and had been catheterized three different times, radiographs being taken each time. The kidneys were visualized and were found to be normal, as was the urine. (I had paid no attention to the spine, for we were looking for a pathological condition of the kidney.) Talking over the case with the cystoscopist, he remarked: "The man must have some pathology somewhere; if not in the kidney, where?" It was then that I looked for something else, and at once noted the spine, which showed a marked spondylitis.

Following this case I was more careful in looking over plates taken because of gastric and kidney conditions, and was surprised at the number that showed spurs and other conditions of the lumbar spine. There is no doubt in my mind that in many of the cases it was these pathological conditions in the spine that led these patients to consult their physicians, who had been misled by the referred pain to some abdominal organ or viscus.

The mistake is often made of inferring that spondylitis is always accompanied by rigidity or stiffness of the spine. A number of cases that I have looked over have had no perceptible stiffness, or at least not more than one would expect for the given age.

Just what is the cause of spondylitis is still a mooted question. Some consider

that it is just a part of a general rheumatoid condition that for some unknown reason has affected the spine rather than some other joint. If this be true, why does it nearly always select the lumbar vertebræ? The orthopedist, McCarthy, of Philadelphia, writing in the *New York Medical Journal* in 1905, considered it a distinct disease entity and pointed out what I also have noted—that the pain in these cases is usually referred to some distant point and seldom to the seat of the pathology. The studies and writings of Marie, Baumlér and Struempell cite a number of possible causes for the condition, but unite on no one thing. In the last American edition of Struempell's "Practice of Medicine," he devotes only a few lines to the condition, and that to the terminal pathology, indicating that probably he was weary of the war of words and wanted peace. Bechterew approaches the subject from the rheumatic point of view entirely, and, I think, rightly attributes the pain to the pinching of the nerve roots by the new deposits. Silver, in 1907, arranged 86 cases, all following acute infections; just how long after the infection he does not say, but he implies that the condition was a terminal toxic one. On the other hand, he quotes Van Amstell as believing that spondylitis is a distinct disease and not a symptom of something else.

Diller and Wright, in the *Journal of the American Medical Association* of May, 1908, decided from statistics that spondylitis is three times as frequent among men as among women. In my limited experience (I have looked over a thousand plates taken for various conditions of the abdomen and chest), nearly all have been in men. The youngest case I have found was twenty-seven and the average age was over forty. It must be remembered that this was a survey of old plates in which spondy-

¹Read before the Radiological Society of North America, Rochester, Minnesota, December, 1923.

litis had not been looked for nor expected. Therefore, I make no pretense to their having any great scientific value, for the survey was too superficial and hurried, but it does have some value as pointing the way to a more careful study in the future. My main point is to impress on roentgenologists the importance of the subject so that they will be on guard and look for spondylitis in all obscure abdominal conditions.

In the medium and advanced cases, spondylitis is easily diagnosed in a fair X-ray plate, for it does not affect the bony structure as does tuberculosis or the Charcot spine, but confines itself to the intervertebral spaces. Even the so-called "exostoses" probably are calcified fragments of the ligaments. The rounded appearance of the bodies of the spine in the "Marie-Struempell" type is due to the distention of the capsular ligaments with an exudate, and owing to the extreme density of the spinal ligaments this exudate is retained until in very late cases it becomes calcified, resulting in the so-called "poker back," or, as I believe often happens, it is absorbed and only spicules remain to show that such a process had taken place. All other diseases of the spine affect the bony parts, and usually the bodies of the vertebræ.

It is true that in the early stages there is nothing to guide one so far as the radiograph goes. It is my belief, however, that all cases at some time in the course of the disease show this scalloped effect, and that the late signs, such as the horny spicules, are a later manifestation and in many cases the final stage where the disease is arrested, for it seems preposterous to me to assume that all these cases go on to complete calcification and rigidity of the spine. However, this paper has not to do with disputed questions of pathology, but rather to point out some of the conditions it—spondylitis—at times simulates, and, as I have said before, put you on your guard when obscure abdominal conditions present themselves; also to emphasize my opinion that the "Marie-Struempell" type is not a type at all, but a stage of the disease.

I will hurriedly run over some cases of three classes: first, those that have given symptoms of other disease, but in which nothing but spondylitis was found; second, others in which a pathological condition of some viscus was found, but in which unsuspected late-stage spondylitis accompanied it; and third, one case where the middle stage ("Marie-Struempell") accompanied an acute ulcer of the stomach, suggesting the query as to which came first. The first case, V. D., aged 66, was examined roentgenologically for stomach pathology. He gave no history of any back trouble except occasional mild attacks of lumbago. X-ray diagnosis was pyloric ulcer, which was confirmed at operation. Later, on looking over the plates an old spondylitis was found. The second case, E. P., aged 41, came to the hospital for kidney trouble. He had radiating pains from the region of the right kidney down into the bladder, sometimes so violent as to need morphine hypodermically. Cystoscopic and radiographic examinations were negative, but a very marked "Marie-Struempell" spondylitis was discovered. The third case, C. F., aged 53, was irradiated for gastric disease. A diagnosis of chronic cholecystitis was made. At operation no pathology whatever was found in the abdomen. Looking over the plates later we found a late-stage spondylitis. This man gave no history whatever of pain in the back; all his symptoms pointed to the gall bladder and stomach. The fourth case was a young man of 27 who also came in for stomach examination. The radiographic examination report was "ulcer in pyloric end of stomach." The patient was operated upon and an ulcer was found, but the pain persisted subsequent to gastro-enterostomy. Again going over the plates, we found a spondylitis. The fifth and last case was an Italian laborer, aged 32. His chief complaint was pain in the back in the region of the kidneys, and sharp pains radiating down the thigh. Radiographs and cystoscopic examination were both negative, but a part of the lower lumbar vertebræ showed spondylitis.

In conclusion may I, for the sake of emphasis, again reiterate my chief points. Spondylitis is much more frequent than most of us have been led to suppose. Spondylitis is in all probability a definite disease, and terminates in many cases by spontaneous cure; it does not always go on to calcification, resulting in stiffness of the spine, as we have been generally led to believe. Lastly, I believe that the different forms of the disease as seen in the X-ray plate are simply different stages of the disease, and not various types of infection.

DISCUSSION

DR. MARY E. HANKS (Chicago): This has been especially interesting to me because in seven years' work with fibroids I have been convinced that these lesions in the lower spine are important causative factors, and I very much hope that this work can be followed up. The impingement upon the nerves, with resulting soreness, is very positively shown in examining the pelvis. The sensitive points in the pelvis are many times immediately over those nerves that come into the pelvis, and I have seen marked engorgement of blood in these cases. I think that the intense continuous congestion can cause pathologies.

DR. MOORE: After hearing Dr. George's paper,¹ it seems to me that my attempt to try to find out just how frequently the sacralized transverse process occurs and what, if any, significance it has, is justified. I hope that I will be able to show that it is of some significance. But the point that Dr. George dwelt on, that in personal injury cases we correctly separate morphological changes from those that are congenital, is, in my opinion, of the utmost importance. It is for this reason that my attempt to understand the lumbar region of the spine, led me first of all to study the sacralized transverse process.

DR. I. S. TROSTLER (Chicago): The paper by Dr. George seems to me to be one of the most valuable presentations at this meeting from the diagnostic standpoint. We have been trying for many years to stabilize and standardize our work. The recent work of Dr. Hickey in regard to the description of fractures, and papers of the type of Dr. George's, are of the sort that radiology needs. The helter-skelter, any old way, of describing our findings that has been in use for the last twenty-five years, one man describing his findings in one way, while his contemporary described his in another, has to quite an extent thrown radiology into disrepute. A systematic methodical way of doing things, describing our findings and making our reports, will do more to set our science on the high plane where it belongs than anything else we can do.

In regard to the spine, particularly spina bifida occulta, it might be worth while to mention an incident that occurred to me last summer. A prominent ball player was fined for some infraction of the rules, and the same day received an injury while sliding for a base. Physically, nothing could be found, but the radiologist at one of our hospitals reported that he had a fracture of the fifth lumbar vertebra. The physician who has the medical care of the club asked me to see the films. I examined them and found that there was a small gap between the laminae of the arch of the fifth lumbar vertebra, a spina bifida, but no other evidence of departure from the normal. I so reported, and that sulky ball player played ball the next day.

Dr. Ullmann's paper gave us other good points. He usually does that. I think that the Society is to be congratulated upon this very fine symposium upon the spine.

DR. MOORE (closing): All I would like to say is that the point Dr. Wallace tried to make, if I understood him correctly, was one of the things that influenced me in trying to find out about sacralization; the very frequent occurrence of abdominal symptoms without discoverable pathological

¹Fundamental Facts Relative to the Study of the Vertebrae in Industrial Accident Cases, A. W. George and Ralph D. Leonard (read by Dr. George), published in *RADIOLOGY*, April, 1924, p. 197.

process in the viscera. I have even known of such cases going to section for kidney stones, gallstones, etc., and I think his work is even more important, perhaps, than he thinks it is. I recall a physician's wife who came in with symptoms exactly those of gastric ulcer. She came to my colleague, Dr. Mills, who thought there was something wrong with the spine and turned the case over to me. The radiogram showed fracture of a thoracic vertebra. I believe any of those spinal conditions are capable of producing severe abdominal symptoms.

DR. H. J. ULLMANN (closing): I have seen many cases of spondylitis without symptoms, which were discovered accidentally when making examinations for other conditions. It is not at all uncommon. I was very much impressed with the "Marie-Struempell" type that Dr. Wallace saw in the East. Out West more of them have spurs.

DR. WALLACE (closing): There is nothing more to be said about my cases.

I might say of Dr. George's paper that special disease might very easily follow accidents to the spine. When you have an injury to the blood supply of any particular part, and an injury to the vasomotor nerves controlling the blood supply, it is easy to have a condition of pathology that will show on the radiographic plate, such as the Campbell's disease. The injury interferes with the blood supply and gradually the lack of nutrition causes a lessening of the density of the part.

This body does not seem to take kindly to my idea that people may have spondylitis and not know it, and their physicians not suspect it either. But I know I find it quite frequently where it has not been suspected, and I believe that if you all will look over your gastric and kidney plates carefully you, too, will find many unsuspected cases.

Benign tumor of the stomach.—This report is based on the roentgenologic findings in twenty-three cases of benign tumor of the stomach operated on at the Mayo Clinic. The average age was forty-four years. Pathologically the tumors were classified as follows: leiomyoma, two; hemangioma, five; polyposis, two; simple myoma, three; dermoid, one; fibromyoma, seven; adenomyoma, two; single polypus, one.

The growth was located in the cardiac end of the stomach in two cases, in the middle portion in seven, and in the pyloric portion in twelve. In one case of polyposis practically the entire stomach was involved. The lesion was located on the posterior wall in nine cases, on the anterior wall in seven, on both walls in two, on the greater curvature in two, and the location was not mentioned in three cases.

In five cases the complaint simulated carcinoma of the stomach. In four cases the history simulated that of ulcer. In ten cases the symptoms were extremely indefinite. In four cases the principal and practically only complaint was hemorrhage from the gastro-intestinal tract. Eleven cases had either melena or hematemesis. Gastric retention was noted in three cases.

Benign gastric tumors manifest certain roent-

genographic signs, which differ from those found in malignant or inflammatory lesions.

1. They produce a filling defect that is circumscribed and punched out in appearance.
2. The filling defect is usually on the gastric walls, leaving the curvatures regular and pliant.
3. While the rugæ are obliterated in the immediate area of the tumor, just as in inflammatory and malignant lesions, those surrounding a benign tumor are more nearly normal in their appearance and distribution.
4. They cause little or no disturbance in peristalsis, and retention is uncommon, except when the lesion is at, or very near, the pylorus.
5. They do not reveal a niche, nor is there any incisura or other evidence of spasm.
6. They are rarely sufficiently large to be palpated.

While these signs are not pathognomonic of benign gastric tumor, nevertheless, when noted, the roentgenologist should hesitate to report the lesion as malignant and inoperable, especially if the clinical manifestations are indefinite.

A Roentgenologic Study of Benign Tumors of the Stomach. A. B. Moore. *Am. Jour. Roentgenol.*, XI, Jan., 1924, p. 61.

THE MEASUREMENT OF INTENSIFYING FACTORS OF X-RAY INTENSIFYING SCREENS*

By R. B. WILSEY

Communication No. 201, from the Research Laboratory of the Eastman Kodak Company

IT would seem that the simplest way to determine the intensifying factor of a screen would be to place a film, with part of it in contact with the screen, under an X-ray tube, and by a series of exposures on successive areas, find the ratio of exposures which give equal densities on the screened and unscreened portions. Such a method is described in the *Army X-ray Manual*¹ and is illustrated in Figure 1; the half of the film in contact with the screen has been given an exposure producing a half-tone density, and the other half has had successive multiples of this exposure; the intensifying factor is determined by the exposure on the unscreened portion of the film which matches the density of the screened portion.

On the basis of tests by this method, intensifying factors in the neighborhood of 20 or 30 have been claimed for screens when the true factor was of the order of 1/5 of such values. The reason for this discrepancy lies in the fact that the intensifying effect varies considerably with the conditions under which a screen is exposed. The intensifying factor is increased by increasing the intensity or hardness of the X-rays, or by diminishing the proportion of scattered rays. Thus the intensifying factor is quite different according as the screen is exposed to the direct rays from the tube or is exposed through a thick part of the human body under the usual conditions of practical radiography. The intensifying factor varies somewhat with the part radiographed and with the tube voltage, current, target-film distance, density of radiograph, and the amount of scattered radiation permitted to reach the screen; hence, in reality, there is no one value which will fit accurately all the conditions under which screens are used.

It is obvious that intensifying factors measured under any arbitrarily chosen conditions cannot be relied upon to give useful values. However, there is a possibility that by a suitable choice of conditions, intensifying factors can be obtained which will fit

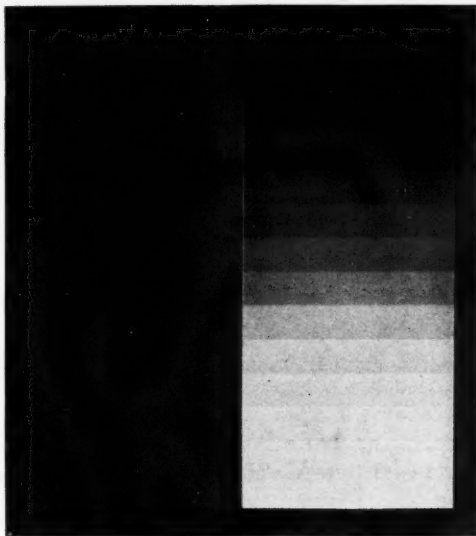


Fig. 1. Illustration of one method of measuring intensifying screen factors. This method cannot be relied upon unless the exposures are made under the proper conditions.

practical conditions sufficiently well to serve as a reliable guide to exposure, and which can be used in comparing the merits of various screens.

Intensifying screens are used generally with only the thicker parts of the human body and with the usual conditions of five-inch gap or 60 kv., 10 to 30 ma., and 20 to 25 target-film distance. These variations in conditions do not greatly affect the intensifying effect of a screen, and an average value of the intensifying factor should fit them all sufficiently well for practical purposes. By the use of a wax knee or similar

¹U. S. Army X-ray Manual, 1919, pp. 112, 113.

*Read before the Radiological Society of North America, Rochester, Minnesota, December, 1923.

test object, the intensifying factor may be determined by the ratio of the exposures with and without screens that give equal average density of radiograph, and the factor so determined may be used satisfactorily

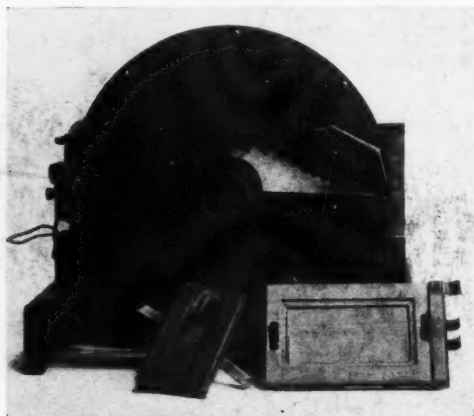


Fig. 2 A. (Front view.) Sensitometer, or exposing machine, for the convenient determination of intensifying factors of screens.

for any thick part of a live subject. However, such a cut-and-try method of measuring screen factors is somewhat laborious, especially when a large number of screens are to be tested. The first-named method is much more convenient, and it was believed worth while to investigate whether it could be made to give reliable results by the proper choice of conditions.

It seemed that the problem would be solved if the intensity and quality of the radiation reaching the screen under the usual conditions of radiography could be approximately duplicated in a simple experimental arrangement. In the absence of accurate data on the representative or average character of the radiation reaching intensifying screens in roentgenological practice, it was necessary to make several assumptions and compromises that seemed reasonable in the light of existing knowledge. It was assumed, first, that a volume of water 15 cm. deep by 30 cm. square would be equivalent in its absorption and scattering to the average thick part of the human body. Sixty kv. was taken as the

standard radiographic voltage and 20 inches for the target-film distance. To agree with the most common practice, the tube current should be made 30 milliamperes, but in order to use longer and more accu-

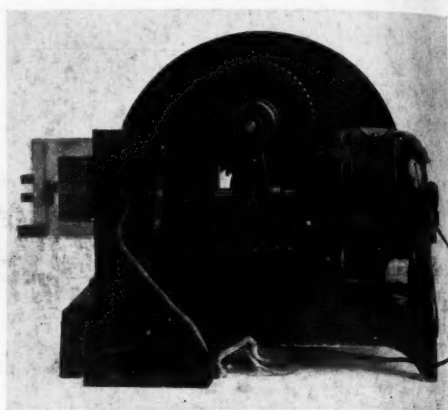


Fig. 2 B. Rear view of Fig. 2 A.

rately measurable time intervals for the exposures, the current chosen was 10 milliamperes.

From the absorption measurements of Richtmyer,² it was calculated that practically the same quality of primary radiation is transmitted by one centimeter of aluminum as by fifteen centimeters of water. With the further aid of data on the scattering of X-rays in this depth of water,³ it was calculated that the total intensity of the radiation transmitted by the aluminum is 2.5 times that transmitted by the water; hence, if a 1 cm. aluminum filter be substituted for 15 cm. of water, the tube current must be reduced in ratio of 2.5 to 1 or from 10 to 4 milliamperes, in order to obtain the same X-ray intensity.

The conditions for exposing the screens will then be as follows: 60 kv., 4 ma., 20-inch target-film distance and one centimeter of aluminum filter. These conditions give a beam with a negligible proportion of scattered radiation, whereas with water, most of the radiation transmitted is scattered radiation. A correction must, therefore, be made to take account of the differ-

²F. K. Richtmyer, *Phys. Rev.*, July, 1921, p. 13.
³R. B. Wilsey, *Am. J. Roent.*, Oct., 1921, p. 589.

ence in the sensitivity of screens to scattered and direct rays. This correction can be calculated from previous data,⁴ but for the present purpose it was measured directly for the sake of higher accuracy. It was found that intensifying factors determined

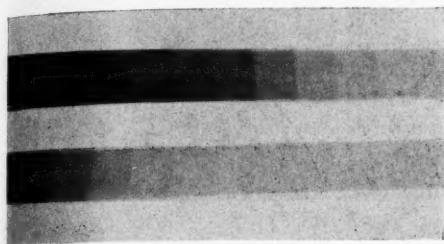


Fig. 3. Film obtained with intensifying screen sensitometer. Both portions of the film have been given the same series of exposures; one strip was exposed with an intensifying screen, the other strip without screens.

with one centimeter of aluminum filter could be reduced to those obtained with 15 cm. of water by multiplying by the following correction factors: 0.83 for single screens, and 0.78 for double screens. Furthermore, the portion of the film used with screens should be covered with aluminum of the thickness used in cassettes, and the unscreened portion of the film with cardboard such as is used in exposure holders.

For convenience in exposing the films, an instrument was constructed which automatically gave a suitable series of exposures. It is illustrated in the photographs of Fig. 2, *A* and *B*. A sector disk is driven at constant speed by a governed motor and train of gears. It rotates in front of the film holder and the various apertures give same series of exposures to both halves of the film. The angular dimensions of each of the thirteen apertures if $\sqrt{2}$ times that of the next smaller aperture; such a series of exposures gives a uniform spacing of abscissa values when plotted on a logarithmic scale. Fig. 3 shows a reproduction of a film exposed in this instrument. The densities on the film are read with the photometer, density-exposure curves are plotted, and from these curves the relative exposures are found which give equal densities

on the screened and unscreened portion of the film. The ratio of the exposure without screens to that with screens is multiplied by the appropriate correction factor for scattered radiation to obtain the intensifying factor.

Since the intensifying factor increases somewhat with increasing density of negative, it is necessary to choose some density value as the standard for which all factors are to be determined; this density was taken as 1.0 (transmission 10 per cent), which is estimated to be the average density of negative obtained in practical radiography.

The films are developed in a tray of X-ray developer for four minutes at 65° F.; this development is equivalent to the standard five-minute tank development. Continuous and irregular motion of the developer over the film surface, as occurs in rocking a tray, is preferable to still tank development for films used in exposure or intensity measurements, as it gives more uniform development and lessens the errors of measurement.

To test the reliability of this method of measuring intensifying factors, it was used to measure the single and double screen factors of a number of screens of various speeds, and the factors thus determined were checked by radiographs of a wax knee. In every case the exposure value based on the experimentally measured factor gave a radiograph with closely the same average density as the standard exposure without screens. This result showed clearly that the factors as determined by this method could be used as reliable guides to exposures with screens, and furthermore, the method provides a convenient and accurate method of comparing the speeds of various screens. It may also be used to compare the speeds of different types of film when used with the same screen. The method is now being used in our laboratory for routine measurements of the factors or speeds of intensifying screens and the screen speeds of X-ray films.

While the exposing instrument or sensitometer and accessory equipment for read-

⁴Ibid.

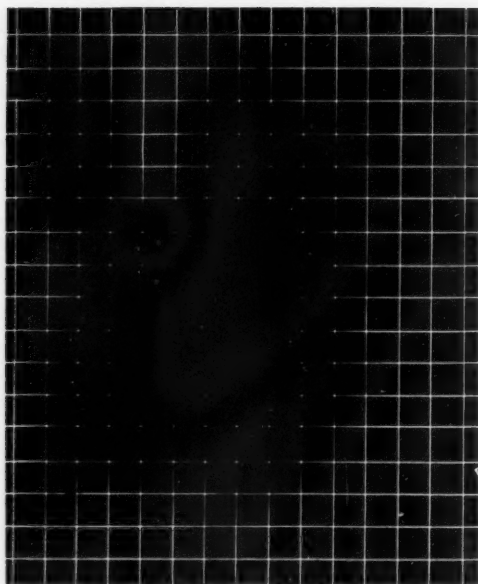


Fig. 4 A. Test of contact between intensifying screen and film in cassette with rigid cover lined with thin hard felt. The test shows poor contact in central area.

ing the densities are of great convenience and permit higher accuracy, they are not essential to the method, as the exposures may be made by hand and the densities judged by visual inspection; the important features are the conditions of tube voltage, current, distance, and filtration by which the exposures are made. Any X-ray worker may thus determine the factors of his screens or compare the speeds of two or more different screens, and the results should be valid for radiograph work done with the particular type of machine and film used in making the test.

In connection with these experiments, it may be of interest to report some results obtained with a new method of testing the contact between film and screens in cassettes. A screen is ruled with cross-lines; a cleanable screen may be ruled with a grease pencil and the lines afterward washed off, or an old screen may be ruled with ink.⁵

Fig. 4 A shows such a test made in a cas-

⁵This test was suggested to the writer by Mr. F. C. Martin, of the Medical Division, Eastman Kodak Co.

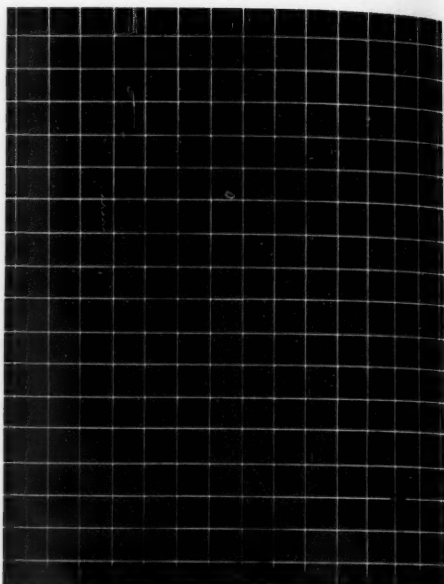


Fig. 4 B. Contact test with same cassette; the padding on the cover has been reinforced with a layer of thick soft felt. The test shows good contact over the whole film.

sette which had a rigid back lined with a thin hard felt. The cassette had been in use for several years and the aluminum

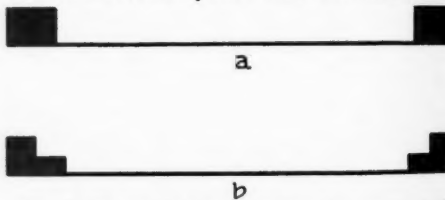


Fig. 5. For convenience in loading, the cassette should have straight sides, as illustrated in cross-section at (a). The ledge shown at (b) gives difficulty in adjusting screens in correct position.

front had become permanently bulged out. The test shows the effect of this upon the contact between the film and the screen; the contact is good at the edges but is quite poor over the central area. The padding on the cover of the cassette was then reinforced with a layer of thick soft felt, and the test shown in Fig. 4 B was obtained; the contact appears good over the whole area of the film. This experiment demonstrates the fallacy of providing a cassette with a rigid back; the thin aluminum front of the

cassette is bound to stretch and bulge out to some extent under pressure, and as time goes on, this bulge is apt to increase and become permanent. The cover of the cassette should be slightly flexible and should be lined with a pad of thick soft felt, an air cushion, or other material that will compensate for the deformation of the front of the cassette.

For convenience in using the cassette, the cover should preferably be hinged per-

manently to the cassette in a manner that allows for variations in the thicknesses of screens. In loading the cassette, the screens and film should fall automatically into the correct position without the necessity of adjusting them. For this reason the straight sides, as illustrated in Fig. 5(a) are preferable to the ledge, as shown in Fig. 5(b). In addition, the cassette should be as light and thin as is consistent with substantial construction.

CASE REPORTS

LYMPHOSARCOMA OF THE STOMACH

REPORT OF A CASE

By DONNAN B. HARDING, M.D., Fellow in Roentgenology, The Mayo Foundation, Rochester, Minn.

Because of the relative infrequency of lymphosarcoma of the stomach, the following case report is submitted:

Case A182060, a boy, aged sixteen years, came to the Mayo Clinic in January, 1917, complaining of pain in the left abdomen, which had troubled him at intervals for four months. It usually came on about three hours after meals, and lasted only an hour or two. Occasionally, he had obtained slight relief by taking soda or food. There were no other symptoms, and except for these intermittent pains, the boy felt well. On physical examination, a palpable mass was found beneath the left costal margin, which was thought to be an enlarged spleen. The hemoglobin was 30 per cent; erythrocytes 3,350,000; leukocytes 7,200. The smears for differential counts were normal except for slight anisocytosis of the erythrocytes. Gastric analysis revealed free acid 10, and total acidity 20. Roentgen-ray examination of the stomach disclosed a large filling defect on the greater curvature of the body of the stomach, extending almost to the cardia (Fig. 1). This filling defect, associated with a palpable mass, presented a picture which could not be dif-

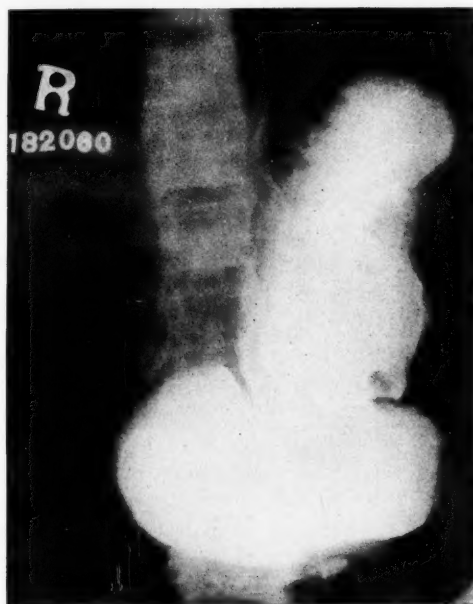


Fig. 1. Gross filling defect seen in vertical portion of the stomach along the greater curvature and posterior wall.

ferentiated from carcinoma of the stomach. The patient refused operation. A short time after going home, he developed a severe hemorrhage by bowel, and the mass in the abdomen increased markedly in size.

He returned to the Mayo Clinic in March, 1917, for operation. A laparotomy revealed a large tumor growing from the pos-

terior wall of the stomach, almost filling the stomach cavity, and extending upward under the dome of the diaphragm. A specimen excised for diagnosis was reported by the pathologist to be lymphosarcoma. After an uneventful post-operative course, the patient was given one X-ray treatment and sent home. He died April 20, 1917.

APPENDICEAL ABSCESS WITH CONCRETIONS AROUND A PIN

By CHARLES G. SUTHERLAND, M.B. (Tor.), Associate in Section on Radiology, Mayo Clinic, Rochester, Minn.

Case A118190. A woman, aged thirty-one years, came to the Clinic, October 30, 1914, because of pain and tenderness in



Fig. 1 (Case A118190). Roentgenogram showing concretion in the appendix formed about a pin as a nucleus.

the right iliac fossa, and a palpable mass. The pain was sometimes stabbing in character when she walked. Three years before she had swallowed one of a mouthful of pins, and one week later the pain had developed. She had first noticed a mass in the right iliac fossa in March. For two or three years she had been constipated; this was aggravated after an attack of influenza in the spring of 1913. She had had intermittent attacks of diarrhea, when the fecal matter "burned" her. Considerable mucus passed with the stool, and sometimes blood. Definite intolerance to acid fruits during this period was associated every day for a time with intermittent attacks of gas pains after eating, with slight relief by passing gas by bowel. X-ray revealed the pin, corresponding to a palpable mass, in the right iliac fossa, behind and to the outer side of the colon. Operation was advised, but was declined and the patient returned home. May 19, 1916, she again came to the Clinic. The right iliac mass had increased in size. The intermittent cramps persisted, and were temporarily relieved by purgation; the stools were green in color and offensive in odor.

Operation, May 24, revealed an appendiceal abscess, containing from 60 to 90 c.c. of thick pus and a concretion (Fig. 1), 2.5 cm. long and 1.5 cm. wide, with a pin in the center. The tip had separated from the rest of the appendix, but was removed with the mass. The patient's hospital convalescence was uneventful, but in August, after riding over a rough road, an inflammatory condition in the right iliac fossa developed. This subsided, however, with rest in bed and the application of an ice bag. Complete recovery followed.

THE ROENTGEN RAY AS A REMEDY IN FIBROMYOMATA AND OTHER BENIGN GYNECOLOGIC DISEASES: A REVIEW OF 222 CASES¹

By MARY ELIZABETH HANKS, M.D., CHICAGO

IN this review of all gynecologic cases of my records—totaling 222—I have referred to some previously reported in order to make this presentation complete. Throughout seven years' experience I have endeavored to keep an open mind, freely allowing my opinions to change. But on one major issue, the practicability of X-ray in gynecology, my convictions are increasingly favorable. It is also true that my more mature judgment confirms my earlier belief that in benign gynecologic diseases the lower voltage, with abundant time for readjustment, is a safe and effective practice. This conclusion is confirmed by many roentgen therapists.

Holzkecht (1) recommends the single maximum dose in the treatment of malignant tumors alone, and observes that in a few individuals, who failed to complete the series of treatments, "half or less of the ovary dose was sufficient to stop menstruation." He continues: "It is my belief, therefore, that we do not have the right, simply for the purpose of maintaining a uniform and easily conducted roentgen therapy method, to destroy more in the cure of a single case than is physiologically warranted." His conclusion seems incontrovertible.

According to the observation of Bécélère (2) the single intensive dose is not always followed by amenorrhea, nor is the menopause always permanent. This also indicates that no single rule can apply to a group of individuals with widely varying needs and tendencies. Some women at fifty are more virile than others at thirty-five or forty, and more resistant.

To equip for a uniform technic applicable alike to benign and malignant therapy and to diagnosis, to place in charge a technician without clinical experience, who is unfamiliar with the power resident in the

machine and its therapeutic possibilities, is a fallacy. By the way of these practices, many clinical errors enter. It is a delicate job—often done better with an obsolescent equipment in the hands of an expert clinician.

Technic. My technic has undergone no radical change from that described previously.

Spark gap: 23 centimeters (9 inches).

Distance: 18 to 43 centimeters (7 to 17 inches).

Five milliamperes.

Three to five millimeters of aluminum and sole leather as filters.

Time of exposure is from five to seventeen minutes, through as many ports of entry, eight to thirteen centimeters (3 to 5 inches) in diameter, as are required to cover the pathology under treatment. I am now using in the majority of cases 30 centimeters' (12 inches) distance and fifteen minutes' time over fibroid tumors, with a smaller dose over the ovaries.

Intervals between series, three weeks at first—later four, six, eight, or even as many months.

The technic and the number of treatments vary according to the requirements of the disease under consideration.

There is a general agreement that the requirements of the tissues we are discussing are all below the unit skin dose (3). The ovary is about one-third or less, while the glandular tissues and fibromyoma cell are all below 100. With the low voltage, the cross-fire method, and abundant time between series we get the reactions we want and usually avoid roentgen sickness. A patient discouraged in this way is easily persuaded that X-ray is dangerous.

A sudden transition into and through the menopause, no odds how spectacular the

¹Read before the Radiological Society of North America, Rochester, Minnesota, December, 1923.

results, is a regrettable circumstance for two reasons:

First: A stormy menopause usually ensues, which is a biologic and physiologic protest against the precipitate exit from the years of active sex life into the non-productive period—so contrary to Nature's deliberate method.

Second: The short wave-length technic, with longer exposure, more often limits the endocrine output, and a crop of obese women may be one of the conspicuous results. To minimize the endocrine supply of such an important gland as the ovary, to interfere with glandular balance, to plunge a woman into obesity and a climacteric that is wellnigh pathologic, is unjustifiable. If X-ray is applied conservatively menopausal symptoms are mild, obesity is absent, and other secondary sex characteristics are negligible, or much less marked than those which may follow the single maximum dose or radical operation (4).

Roentgen therapists are under critical observation and must be more accurate as to the word "cure," which seems to mean such a variety of things in medical parlance. It should mean "pathology under treatment is so far recovered that it is no longer demonstrable, and that there is a return to normal health." In this report the word is used advisedly.

Tissue changes. The tissue changes induced by X-ray are guides to its use in various pathologies found in gynecologic practice, and indicate how accurate and dependable a remedy X-ray may be. Very briefly they are as follows:

Glandular function in general is stimulated by small doses, but may be destroyed if X-ray is long continued. The utricular and cervical glands are reduced in size and function, and thereby hypertrophy of the endometrium and glandular derangements of the cervix are remedied.

The Graafian follicles are destroyed; with continued raying, the primordial cells will be, thus precluding conception by establishing the menopause (5). The internal secretions, under the small ovarian

dose, seem not to be affected (6), as the interstitial tissue and the corpus luteum are the last to be influenced. This is evidenced by the mild menopause and the continuance of sex health.

In the capillaries an edematous condition of the endothelial lining precedes the eventual obliterative endarteritis which reduces the blood supply, similar to the normal menopause (7).

In the fibromyoma, first the cell nuclei are obliterated, then the entire cell disintegrates, and the leukocytes carry away the detritus (8). Under the smaller serial doses this is done gradually and in many cases completely, without disturbance.

CONTRA-INDICATION FOR X-RAY IN FIBROMYOMATA

Prefacing a consideration of fibromyomata, contra-indications are appropriate. Because of them, I refuse to treat a goodly number of cases. Yet, as experience increases and technic improves, I find contra-indications diminishing.

1. A tumor associated with acute symptoms, such as sudden severe anemia, much tenderness, fever and chilliness, may be necrotic and is at once surgical.

2. A tumor associated with large ovarian tumors (not simple retention cysts) belongs to the surgeon.

3. Pedunculated tumors should be operated upon if the pedicle is slender and the danger of torsion is considerable.

4. A case associated with acute gonorrheal infection is not benefited by X-ray nor yet harmed, though the chronic case may be benefited.

5. A suspicion of malignancy puts the case into the hands of the surgeon, the short wave-length expert, the radium therapist, or all of them.

6. Submucous tumors are apt to be disappointing. Two of my cases that came to operation had submucous growths. Béchère's (9) seven failures in seven hundred cases were all submucous complications.

7. A large non-vascular tumor, made up mainly of connective tissue, does not

yield the best results, although, when it is reduced in size and the menopause established, health and comfort usually follow.

8. A woman who desires children and whose subserous tumors can be enucleated, is a good subject for myomectomy.

Severe anemia has been considered a contra-indication for the method herein described. It is my belief, however, that the delay due to moderate X-ray doses, with good clinical care, is less dangerous than either the single intensive dose or surgery. Radium may be preferable to any of them. Severe anemia, out of proportion to the hemorrhage, points almost certainly to focal infection. In thirteen of my sixteen cases, apical abscesses were responsible. With their removal, recovery of the blood was almost spectacular.

Errors in diagnosis are made by the best gynecologists. But if we remember that any tumor not materially reduced after two or three series belongs to the surgeon, we shall consume little time in error.

General Survey — Fibromyomata. Experience convinces me that size of tumor should not occupy too important a place in prognosis. Large tumors conforming to favorable type may yield to treatment. One tumor coming an inch above the umbilicus has entirely disappeared; on the other hand, one the size of a full term pregnancy was reduced three-quarters when improvement ceased and operation was advised. After much experience Bécélère says: "The size of the tumor has no influence: even in giant myomas, radiotherapy has always produced retrogression . . ." (10).

Neither is the question of age urgent. I have had twenty cases under forty years of age, twelve were thirty-five or less, and the youngest thirty. The younger the woman, the more gradual should be the application of X-ray, thus giving abundant time for readjustment.

The fibroid tumor most susceptible to X-ray is the hemorrhagic intramural, not seriously complicated, growing below the umbilicus and occurring in a woman of forty years or more. These cases, with

judicious treatments, will yield almost 100 per cent in good results. It is this group that furnishes a large percentage of our cures, and fortunately this group is about 72 to 75 per cent of all cases.

There are, however, cases that will not yield results entirely satisfactory and yet may properly belong to X-ray therapy. This class is made up of women who are not good surgical risks, or who can not turn aside from the exacting demands of daily life, or who will not submit to surgery. After a full understanding as to prognosis, all these should be given a choice of procedure, if X-ray promises a relief of symptoms and a return to fair health.

The most important principles of management are diagnosis and prognosis, selection, careful records, and attention to individual needs. Subsequent re-examinations are of prime importance. If these are constant factors I concur with Drs. Eden and Provis of London (11), who contend that "the risks of failures with roentgen-ray treatment in suitably selected cases are so small as to be negligible"; and with Dr. Bécélère (12), who reports from Paris seven hundred cases with only 1 per cent failures; and with many other experienced and careful roentgen therapists.

In this survey I have arrived at my conclusions by records showing the character and tendencies of the tumor, by a knowledge of the condition at the beginning and at the end of treatment, by subsequent examinations when possible, and by reports from the physician referring the case. A large majority of the cases submitted have had confirmatory diagnoses made by other physicians.

After a careful estimate of all cases traced I am convinced that at least 75 per cent of 160 finished cases of fibroid show no demonstrable tumor. This includes the acceptance of some of the less favorable cases, a thing we must in fairness do. There is no doubt that this rate can be maintained with careful selection and good clinical care.

A second group, about 10 per cent, are free from all symptoms, and in excellent health. Tumors, much reduced, are gradually lessening, in no way offend, and may or may not disappear. They are clinically cured, and may yet enter the cured class.

The remainder runs approximately as follows: Seven per cent were relieved, tumor reduced and inoffensive, general health much improved, menopause established, but because of serious associated complications health is endangered. Four of this group died several months after treatment was concluded,—two from chronic heart disease, one from intestinal cancer not associated with the tumor, and one from pneumonia. There were a few unfinished cases who became discouraged or alarmed, and sought relief by some other method, and a few I am unable to trace.

My less satisfactory successes and my failures follow: A discussion of this group may be profitable. In seven years six cases have been operated upon.

The first was a case of myxomyoma, a rare occurrence. This woman, after four series of X-ray and an operation, conceived and delivered at full term a normal child.

The second was a fibroid tumor of the ovary, occupying the median position. There was from the beginning a difference of opinion as to diagnosis and suitability for X-ray. Three series decided the matter and the case was operated upon. Ascites was present, which is typical of these large fibrous tumors of the ovary, though in this case it was probably aggravated at the last by torsion of the pedicle.

In the third and fourth cases, cystadenoma was the surgical diagnosis. In one the original fibroid had disappeared. In the other a multiple fibroid, much smaller than the original, remained, but owing to a very recent hyperthyroidism it was not removed. The established menopause practically insures a further recession.

The fifth was complicated with a submucous growth which provoked hemorrhage even after a disappearance of the inter-

stitial fibroid. A curettage has apparently completed the cure.

The sixth was a large multiple tumor. Earlier the patient was a poor surgical risk. Later she was much improved in health and a total hysterectomy was done successfully. In this case a submucous fibroid accounted for the occasional appearance of blood.

Analyzing these six we find two mistakes in diagnosis, two large ovarian cysts developing long after X-ray was discontinued, two submucous fibroids, in one of which the uterus was saved. There were three cases in which the operation was simplified by the X-ray preface and two of them had become good surgical risks.

Regarding a few of my series, the last chapter of their story has not yet been enacted, but our most friendly and dependable ally in all cases is Time.

Malignancy. After seven years it gratifies me to say that to my knowledge not one of my cases has developed malignancy, either sarcoma or carcinoma. This gives me, however, no false security. But to scare a woman into operation by holding up to her the danger of malignant degeneration is unwarranted and unfair (13). On previous occasions, before this body, I have expressed the belief that X-ray remedies the precancerous state and may even arrest the incipient cancer that has escaped detection. This has now become a conviction, and is in accord with others of wider experience and with better facilities for accurate observation. Apropos of this, the following:

E. Essen Moeller reports 700 operations for myoma followed by the development of 22 malignancies. This is 3.14 per cent (14). On the other hand, Franqué reports roentgen treatment of 200 myomata, followed by malignant degeneration of only one (15). This is one-half of 1 per cent (0.5 per cent). If X-ray has no advantage over surgery, Franqué would be entitled to $6\frac{1}{4}$ cases of malignancy instead of one. It is clear why he thinks "the roentgen ray tends to ward off cancer."

Cullen (16) finds carcinoma of the cervix

in 1 per cent of the myoma cases, and 2 per cent adenocarcinoma of the body of the uterus, complicated with myoma.

According to these various estimates, my series with no cancer should have produced at least four.

I do not agree, therefore, that a uterine fibroid causing no symptoms should receive no treatment. If it is true, as has been well established, that thorough raying influences the precancerous state and thus prevents cancer, why not ray the myomatous uterus before such degenerative processes appear or before pressure symptoms develop? Fibroids neglected invite disaster.

Apropos of the danger of sarcomatous degeneration in myomata, I am of the opinion that Dr. John G. Clark (17) comes very near the truth when he says: "The frequency of sarcomatous transformations in myomata is so small as to be negligible." He continues: "It is quite possible to take out of any fibroid tumor isolated areas which could be mistaken for spindle-cell sarcoma. . . . I am sure, therefore, that the discrepancy in diagnosis lies in this difference of opinion."

X-ray versus radium. Further observation confirms my belief that in many cases X-ray is preferable to radium for the following reasons:

First: The danger of X-ray in experienced hands is negative, while radium in the hands of the best radiologists may be followed by serious results if old inflammatory processes exist (18).

Second: Roentgen ray can be successfully applied without loss of time, inconvenience or discomfort, and without hospitalization, an economy much appreciated by the patient.

Third: The roentgen ray covers a wider field, is more inclusive of possible pathology and stimulates more actively the circulation of lymph and blood.

Fourth: The larger tumor is more successfully reduced by X-ray.

Other pelvic pathologies benefited by X-ray. During my work with X-ray, chiefly on uterine fibromyomata, I have observed

many good results outside the main pathology.

Adhesions. Chronic adhesions and indurated inelastic tissues have long been recognized as yielding most favorably to the X-ray, which promotes a free reparative circulation. Such modification of adhesions will release a tumor which earlier has been altogether fixed. This relief of perimetric adhesions Fraenkel (19) characterizes as a "welcome addition to our armamentarium."

Ovaries. The simple follicular cysts of the ovary originating in the Graafian follicles, also blood cysts of the corpus luteum, are modified by the X-ray. These retention cysts are rarely large, the largest in my series being the size of a lemon or a small orange. In all cases under observation, they either rupture or recede and others do not form. This prediction may now become a part of the prognosis. Large ovarian tumors of any sort belong to the surgeon. They are not prevented, nor caused, nor cured by X-ray.

Cervicitis. In my experience with non-malignant diseases of the cervix, such as erosions and degeneration of cervical glands, no case has failed to come into perfect health, and the accompanying leucorrhea gradually disappears. Some of the erosions have been chronic and threatening, and these are potential cancers. But if they are thoroughly irradiated before actual malignant change occurs, their response to treatment is prompt and satisfactory. To date not one such erosion has recurred. Eighteen of my thirty-five cases recovered promptly during X-ray treatment of a fibroid. Seventeen complicated the case more or less obstinately, but finally recovered completely.

In pruritus. Five cases of pruritus vulvæ have recovered while treating fibroids. Many causes of this malady are usually enumerated, but the most common is leucorrhea. During and after the menopause it is often a slight, watery, excoriating discharge, quite different from the leucorrhea from the usual sources. My technic is

based on a consideration of pelvic pathology as well as of the pruritus. In the average case a series consists of one or two suprapubic exposures, including the entire uterus in addition to the treatment of the pruritic area. Every three weeks this inclusive treatment is repeated, until it has been given five or six times. The result is prolonged relief—or cure. So far I have one refractory case.

Dysmenorrhea. Uncontrolled dysmenorrhea, the failure from all other measures, including surgery, makes up one of our most satisfactory groups. X-ray should be employed even in younger women. In these, moderate doses and longer intervals between series will sufficiently delay the menopause so that the shock is negligible. After the menses disappear it is good to see the long period of semi-invalidism end and the woman resume her living-making occupation or her normal place in family life. I have had eight very satisfactory cases. They should be selected with unusual care.

The menopause. A prolonged, nerve-racking menopause with its familiar train of distressing symptoms, should be terminated by X-ray. The generative organs at this time so readily assume the characteristic atrophic state that three series usually suffice. Not only for the good of the individual, but for the benefit of the entire family, this woman should be brought into a more normal attitude toward her surroundings.

In hemorrhage of the menopause, with no tangible pathology, X-ray is almost specific in any of the more common etiological conditions, as fibrosis, hyperplasia of the mucosa, chronic endometritis.

Hemorrhage in adolescents. Hemorrhage in adolescents was at one time extremely puzzling. But since we have a better understanding of the endocrines we recognize that this usually exemplifies a functional disturbance of the ovaries and possibly other glands. Neither X-ray nor radium should be applied until endocrine therapy, a heavy vitamin diet and selected drugs have been used. Novak (20) and Geist (21)

have demonstrated that there is hyperplasia of the endometrium characterized by an overgrowth of the epithelial and stromal elements, and that this condition is quite constant in the adolescent case. As a last resort, I believe radium is better than X-ray (22). It seems more logical to apply the remedy directly to the endometrium in such small doses that the highly sensitive ovary is not arrested in development. Curettage is contra-indicated.

In displacements. The uterus naturally inclines to the normal position (23). Even after a displacement is continued over a considerable period, when released, the uterus, if normal in weight, may assume the normal position unaided. This I have repeatedly seen, even after fibroid tumors have borne the uterus down for an extended time. X-ray has proven itself to be a valuable remedy for the heavy uterus and the engorged blood vessels, thus favoring spontaneous recovery.

Sterilization. Sterilization is sometimes justified. Physicians and other humanitarians recognize that the welfare of the patient sometimes warrants termination of ovarian function and that certain types should not reproduce their kind.

To illustrate: A woman of thirty-five is fighting an extensive tuberculosis. She must care for three children and a home. Two pregnancies have been terminated upon medical advice. She suffered from severe hemorrhage from an enlarged retroverted uterus. Her urgent needs were two,—the elimination of hemorrhage and of fecundity. I fully concurred with her physician in that solution to her problem. It is also my conviction that X-ray sterilization is proper in habitual criminals, degenerates, submentals and in those who would pass on to their progeny syphilitic blemishes. Roentgenologists can be of distinct service in helping to eliminate undesirable elements from the overburdened human race. So urgent is this work that it has become an emergency and it should be recognized and authorized.

Sexuality. Two years ago from the floor

of this convention, a legitimate question was asked me, namely: "How does X-ray affect a woman sexually?" After painstaking inquiry I can now give a better answer.

It is a mistake to say that after forty or forty-five sex life is not important. The sex impulse and perfect function should be seriously conserved as an important factor in the harmony and contentment of family life. Later in life ovulation is of much less importance than established sex habits and mental poise. According to Bride, of London, total hysterectomy disturbed sex relations in 39 per cent of his cases (24). Fear and psychic instability are prominent symptoms after radical operation. If a woman fears sex disability she often is disabled. If, on the other hand, she knows that her generative organs are intact, as after X-ray, it adds to her belief in her own capacity and this favors normal sex life. My women successfully treated by X-ray are usually unchanged sexually (25). They generally agree that better health, freedom from discomfort and pain during coition, and no fear of conception so liberate them that in some cases there is even improved sexuality.

Burns. Over seven years have passed without a burn. This emphasizes the fact that it is possible to so systematize precautionary measures as to eliminate accident. I cannot too often reiterate: Estimate carefully the dose; check precisely filters; time of exposure and interval between exposures; surround with lead each port of entry; let a painstaking assistant verify every step by counter check; keep the patient under constant observation.

Conclusion. Roentgen therapists too often meet justified criticism because some physicians still use X-ray without precise knowledge from examination and record, and many technicians are authorized to set the machine and throw the switch with no appreciation of the conditions under treatment. As a scientific organization we must exhibit superior skill or we shall deserve criticism rather than recognition. But, despite criticism, the roentgen ray as a rem-

edy in gynecology is coming into its own. During the last twenty years it has been established as accurate, legitimate and without accompanying penalties, *if* applied by the clinician who knows its limitations and the requirements of his patient.

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DISCUSSION

DR. LEDA J. STACY (Rochester): In Dr. Hanks' excellent paper she has called attention to several very important points which I think are the reason for her excellent results. These points are applicable in the use of radium as well as in the use of the X-ray, and it is from the radium side that

I can speak more intelligently. The chief importance is the careful selection of the cases, the careful observation and frequent examination following treatment. Dr. Hanks spoke of the question of pelvic infection. A tumor associated with a history or findings of acute, subacute or chronic pelvic infection is not a case for radiation, either with radium or the X-ray. We feel at the Clinic that the larger tumors are better treated surgically, because of the difficulty in making a definite diagnostic differentiation between an ovarian tumor and a fibroid, and because of the frequently associated chronic inflammation. The woman under thirty-five with one or more fibroids is usually treated more conservatively with surgery than with radium or X-ray. I believe this is brought out by the statistics which have been published from the Mayo Clinic. There have been five full-term pregnancies (living children), and three miscarriages in a series of 288 patients treated with radium during the child-bearing period as against the thirty-four full-term pregnancies occurring following myomectomy, in the 300 cases which Dr. Mayo has reported. The cases of menorrhagia of the menopause have been referred to Dr. Bowing for radium rather than X-ray, thinking that perhaps ovarian function might be conserved by the application of radium which might not be so conserved by the X-ray. The larger tumors filling the pelvis and lower abdomen have been referred to Dr. Bowing for application of radium into the uterus, and to Dr. Desjardins for X-ray over the abdomen, as we believe that the combination of the two gives the best results.

DR. H. H. BOWING (Rochester): I have never been impressed with the amount of radiation given to a patient and the resulting menopause symptoms. The nervous state of the patient has impressed me more. If a patient is inclined to be nervous, I am of the opinion that the menopause symptoms are inclined to be more stormy. In other words, the amount of treatment given,

either in broken doses or in one single dose, has never, in my experience, played any rôle in the intensity of the menopause symptoms; it is controlled by the nervous state of the patient.

Concerning our method of application, as Dr. Stacy mentioned, the radium is supplemented, in certain cases, by X-ray. The patients may come to the Clinic from a long distance; we cannot keep them under observation for long periods, nor can we ask them to return frequently; then, too, they may live in outlying districts in the country where traveling facilities are poor, which would not permit them to go to their own physicians readily; so we have devised a method by which we endeavor to handle them at one sitting. Our policy has been, in the case in which the uterus is of normal size, to apply radium in the uterine cavity, either in sufficient dosage to bring on an artificial menopause or to control menstruation. If the uterus is the size of a three months' pregnancy, we apply radium alone; but if it exceeds a three months' pregnancy and operation is contra-indicated on account of some other systemic condition, we then support the radium treatment with X-ray, and have seen brilliant results follow. This has occurred in cases of huge fibroids which were considered inoperable. I remember one patient with a tumor above the umbilicus and a hemoglobin reading of 10 per cent. Three transfusions were given which brought the hemoglobin up to 30 per cent. Three Universal tube applicators, each containing fifty milligrams of radium element (sulphate), were applied in the uterine cavity in tandem position, filtered through the silver wall of the applicator and about a millimeter and a half of rubber; these were allowed to remain in position for twenty hours. On the fifth day the same arrangement of applicators was reapplied, and again on the subsequent fifth day, giving three treatments in the uterine cavity at three different levels, and then the abdomen was divided into small areas and blocks of radium applied as in the malignant cases. The patient left Rochester with

a hemoglobin reading between 60 and 70 per cent. The bleeding was stopped. The initial result was satisfactory; she came here on a stretcher and walked home. I am confident that it is individual treatment that Dr. Hanks is telling us about, and it is paramount in the treatment of these conditions with radium and X-ray.

DR. WALTER LE FEVRE (Cleveland): I would like to ask Dr. Hanks a question: I would like to ask if in treating cases of fibroid in women past the menopause, she uses her standard technic or tries to hasten matters? Also, if she will explain a little bit what she means by a series of treatments? She mentioned the word "series," but I did not catch what it meant.

DR. HANKS (closing): I want to thank Dr. Stacy for her very kindly criticism of my paper. Of course, you can understand that my office, where I handle my own cases, cannot be compared—(and I felt very hesitant about placing my experience where it could be compared)—with this wonderful organization at the Mayo Clinic. It is entirely different. As I told you to begin with, I refuse many cases because they do not conform to my requirements in the

office. Now, on one point (if I understand Dr. Stacy right), I was quite surprised—that there were only 34 pregnancies in 300 myomectomies. Did I understand that right? I thought there would be many more.

In the average case suitable to X-ray, in a woman who can come into the office every three weeks for a series—I do not see why she should have X-ray and radium, when, with X-ray alone, she can keep on her feet, attend to her business, and get so happily well as she does. All of my cases are so situated that they can come every three weeks, and, of course, that is very different from the cases that report to the Mayo Clinic.

You will notice that all the way through I talked about individualizing your cases. First of all, I am a clinician. I was trained in that first, and, of course, that naturally crops out when I am doing this kind of work. The woman past the menopause does not need nearly so much X-ray; as I said, three series will be ample in those cases, and usually you see the patient three times in about six weeks. I have had them stop and be entirely well after two series.

I think I have covered the ground, and I thank you.

Skin lesions.—To MacKee and Andrews' list of skin diseases favorably influenced by X-ray, the author adds neurofibroma. The choice between X-ray and radium will depend on the size and location of the lesion.

Radiation should rarely be used in the acute inflammatory stage of skin diseases, with the exception of carbuncles and furuncles. In general, skin lesions characterized by itching, induration, chronic infiltration and neoplastic growth will be favorably influenced by X-ray. Itching lesions due to vegetable or animal parasites are not bene-

fited by X-ray. Indurative lesions, such as acne and furunculosis, are usually improved by X-ray treatment. Chronic infiltration, such as eczema, lichen planus and psoriasis, are amenable to X-ray treatment. Skin neoplasms, especially those generally classed as pre-cancerous, are readily eradicated by X-ray.

W. W. WATKINS, M.D.

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SHIFT MEASUREMENTS ON STEREOSCOPIC PLATES

A MEANS OF CORRECTING FALSE OR DOUBTFUL VISUAL IMPRESSIONS

By F. B. STEPHENSON, M.D., DENVER, COLORADO

IN viewing stereoscopic plates it has been my experience frequently to get a false visual impression of the relative depths of different shadows. In a number of cases my impressions, so gained, have been proven false by operative procedure. In talking with other roentgenolo-

gists, I have found some of them have had a like experience. The explanation has been offered that one person will have a different "stereoscopic vision" from another. This seems to be no explanation at all. If one is capable of seeing stereoscopically on most stereoscopic sets, he should presumably be able to repeat the process on all, if they have been properly made. It has seemed to me that often a dense shadow will appear nearer the observer than a softer shadow, when the reverse may be the actual condition. A familiar example is stereoscopic chest plates in which the clavicle may appear posterior to the first rib. In other cases, the observer is simply left in doubt as to the relative position of two shadows.

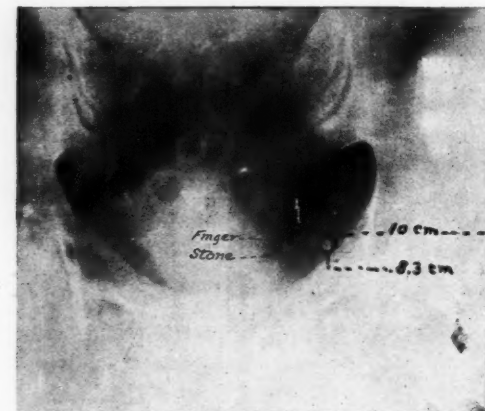


Fig. 1-A.

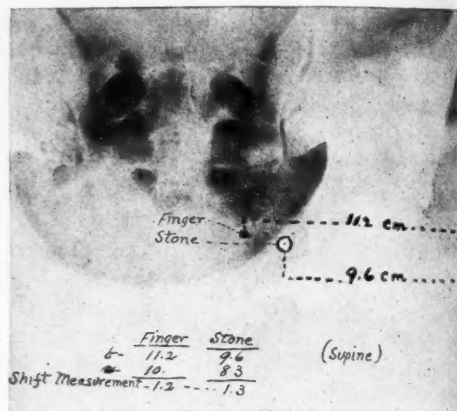


Fig. 1-B.

gists, I have found some of them have had a like experience. The explanation has been offered that one person will have a different "stereoscopic vision" from another. This seems to be no explanation at all. If one is capable of seeing stereoscopically on most stereoscopic sets, he should presumably be able to repeat the process on all, if they have been properly made. It has seemed to me that often a dense shadow will appear nearer the observer than a softer shadow, when the reverse may be the actual condition. A familiar example is stereoscopic chest plates in which the clavicle may appear posterior to the first rib. In other cases, the observer is simply left in doubt as to the relative position of two shadows.

It occurred to me that one's interpretation in this regard could be accurately and definitely checked by what is, in effect, utilizing the well-known principle of localization, in which two exposures are made on

the shadows are visible. As I did not want to undertake to make calculations in every case in which I might be somewhat in doubt, and as superposition of the plates often obscured the shadow in question, I adopted the following easy procedure which I believe will be found a simple and valuable trick for others.

Given a set of stereoscopic plates, select a shadow whose position is known, such as (in the case of the thorax) the edge of a spinal vertebra, the end of a transverse process, or the edge of the aorta. Taking one plate, measure the distance from one or the other edge to the selected landmark and also to the shadow in question. Do the same thing on the other plate (from the corresponding edge). By subtracting the lesser figures on one plate from the greater figures on the other, the distances which the landmark shadow and the other shadow have shifted are obtained. If the patient was in the prone position and the vertebræ

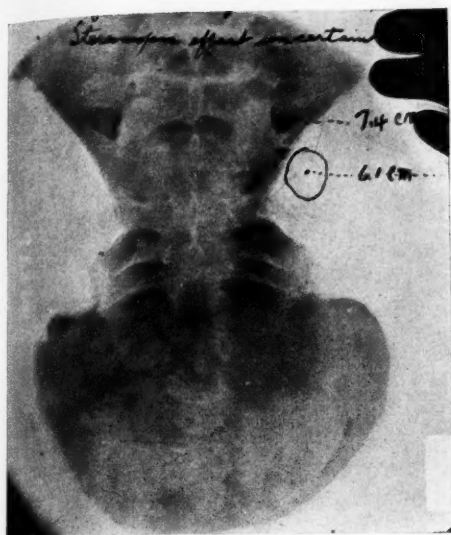


Fig. 2-A.

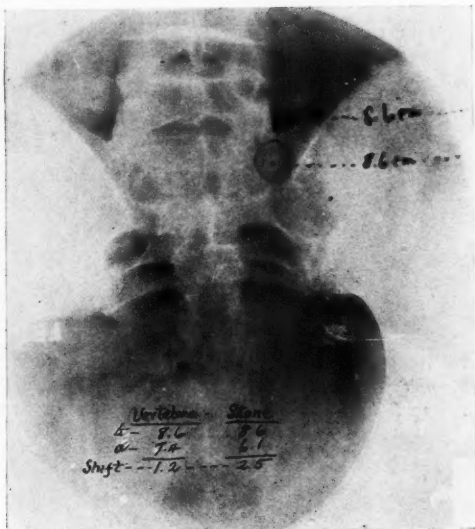


Fig. 2-B.

are thus shown to have shifted more on the plate than the shadow in question, it would show that the latter was closer to the plate, therefore anterior to the spine. If the exact depth is wanted, of course, calculations can be made which will give the exact distance of the object from the plate, but for practical purposes one can estimate mentally the approximate distance, which will vary with the difference in the shifts of the shadows. In my chest plates I uniformly use a 75 cm. target distance and shift 6 cm. If a shadow shifts 1 cm., it is $1/7$ of the tube distance from the plate, or 11 cm. If the shadow shifts 2 cm., it is $2/8$, or $1/4$, of 75 cm., or about 19 cm., from the plate.¹ Therefore, a shadow which shifts 1 cm. would be at about the middle depth in the chest. If it shifted $1/2$ cm., it would be about $1/4$ the way into the chest from the plate. If it shifted $1 1/2$ cm., it would be about $3/4$ of the way through the chest from the plate. A few illustrations of cases in which this device has been of very great help to me will show how readily a doubtful point of depth can be determined without troublesome calculations.

¹This shadow shift will be the same whether the object is in the path of vertical or oblique rays and is therefore a correct factor to use in calculating the vertical distance from any object to plate on the basis of the vertical target-plate distance. Let td = target-plate distance; od = object-plate distance; ts = tube shift; ss = tube shift; ss = shadow shift. The formula then will be: $od = (ss \times td) \text{ divided by } (ss + ts)$.

In this case (Figs. 1, *A* and *B*) of Dr. William M. Spitzer's, the circle marks a soft shadow which would not show well in this reproduction. The crossmark represents the tip of a finger inserted in the rectum and impinging on the seminal vesicles. Stereoscopically, the shadow appeared about an inch posterior to the finger (confirmed by another roentgenologist) and was pronounced not to be a vesical calculus. Nevertheless, the urologist felt sure of his diagnosis, operated, and found a calculus in the seminal vesicle which would cause such a shadow as that seen. After I began measuring shifts I remembered this case, got the plates out, and found that the finger shifted 1.2 cm. and the shadow shifted 1.3 cm., showing that they were practically in the same depth plane. Measurements at the time of the examination would have saved the roentgenologist's face.

The shadow in this case (Figs. 2, *A* and *B*) is within the encircled area and about the size of an ordinary pea. Stereoscopically, it appeared to be back of the ilium. The shift was found to measure 2.5 cm. (50 cm. target distance used), while the edge of the fifth vertebra shifted only 1.2 cm. The patient was supine and the object was thus determined to be anterior to the lateral edge of the vertebra.

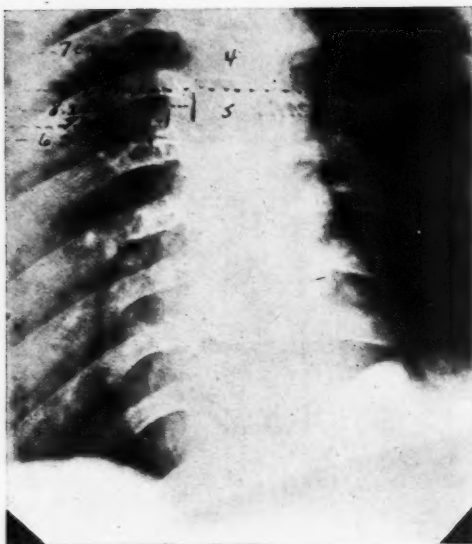


Fig. 3-A.

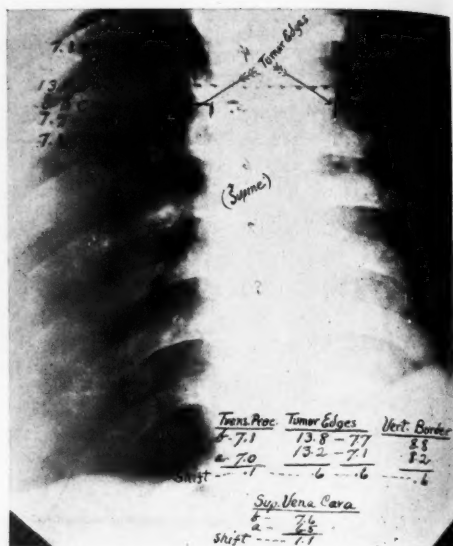


Fig. 3-B.

It was therefore taken to be a calculus in the ureter. This was confirmed by catheterization. (Case of Dr. J. J. Waring.)

These plates (Figs. 3, *A* and *B*) were taken with a portable machine some distance in the country. It was a case of complete paralysis below the waist line in a boy of sixteen years which had developed in about three days, starting with numbness and loss of muscular control of the legs. There was loss of voluntary control of bladder and bowels, but the reflex control was unimpaired. The neurological examination led to a diagnosis of hysteria. When the case did not clear up under the prescribed methods of handling it, the X-ray work was done. No injury or disease of the spine at the point suspected was demonstrated. All appeared normal. There was, however, an indefinite rounded shadow which was rather confused with the superior vena cava and the aortic arch and which, seen stereoscopically, could not be differentiated from great vessel shadows. A negative diagnosis was given at this time to the referring physician, Dr. J. M. Barney, but about one week later in studying over the plates, I conceived this idea of measuring the shift of the shadow, such a

procedure never having occurred to me before. I found that the outline of the rounded shadow shifted the same as the edge of the vertebra, and a trifle more than the transverse process (patient supine). This lead me to revise my diagnosis and report that there was X-ray evidence of a mass surrounding the fifth dorsal vertebra. The case did not improve and two months later tumors developed over the body which were pronounced sarcomata, and a diagnosis of sarcoma involving the spinal column was made by the neurologist.

This case (Figs. 4, *A* and *B*) was referred by Drs. F. P. Gengenbach and R. P. Forbes with request for chest examination, having in mind enlarged tracheo-bronchial glands. History of run-down condition; under their care three months; overweight now; runs fever part of the time; good appetite; sleeps well; father now in a tuberculosis sanatorium.

Although the widened shadow in the upper mediastinal region was thought to be an enlarged thymus gland, it was uncertain, when viewed stereoscopically, as to whether it was forward or backward in the mediastinum. Measurements showed that it shifted practically the same distance as



Fig. 4-A.



Fig. 4-B.

the edge of the manubrium, and would, accordingly, be close against the sternum. Diagnosis of enlarged thymus was, therefore, made in preference to mediastinal newgrowth or glandular mass.

This little procedure seems so obvious that it must have occurred to many others, and, for all I know, may be in use by others, but in my reading I have not seen it mentioned. The only reference I have seen bearing on the principle is in Knox's volume on *Radiography*, 1917, p. 155, in which he suggests super-position of stereoscopic plates for use in the cross-wire method of exact localization. My suggestion is

meant for the interpretation of various density-depths by comparison, using measurements which are easily carried out at the viewing box in a few minutes. One may often get sufficient information by simply making a visual comparison of the plates, without actual measurement. The fact that in the case of spherical or cylindrical objects the edge of the shadow will come from a different point on the surface of the object after shifting the tube, is negligible for practical purposes, because the tube shift is so small in comparison with the target-plate distance.

IONOMETER FOR RELATIVE MEASUREMENT OF PRIMARY X-RAYS

By DR. A. MUTSCHELLER, NEW YORK

1. THE present-day methods employed for measuring the intensity of X-rays are selectively sensitive for different wave lengths and, therefore, they do not furnish any reliable information about the qualitative composition of the beam or the amount of scattered radiation included in the measured portion. There is probably only one iontoquantimeter in existence which, by elaborate tests, has been found to be correctly designed and adjusted so

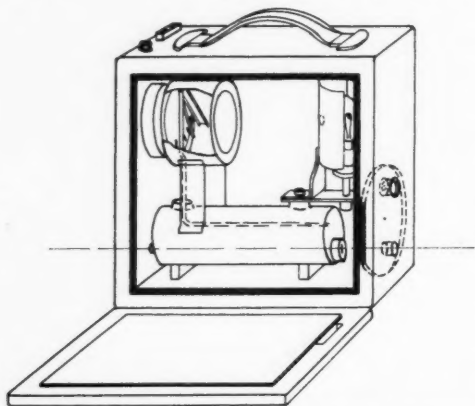


Fig. 1 is a schematic view of the ionization chamber, the electroscopical unit and the illuminating apparatus. Also the protective cover for the electroscopical unit and the device for changing the absorber thicknesses are shown.

as to measure in true proportion to the biological effects. The instrument referred to is that of Prof. Friedrich of Berlin.

Moreover, most instruments now in use are patterned more or less accurately after that standard instrument and proof of their accuracy or absolute standardization is not generally available or dependable. For this reason *absolute* quantitative measuring instruments may give rise to faulty results if their adjustments are only the least bit off, and to avoid serious errors it is from time to time necessary that their sensitiveness be compared with a standard instrument or with radium.

2. By following a process of reasoning based on a somewhat different principle, an instrument for *relative measurements* has

been developed, wherein the misleading effects of secondary rays are avoided and which for accuracy does not depend on calibration of its sensitiveness. The results obtained with this instrument can be subjected to a visible test and thus possible errors of adjustment or of measuring are revealed during the making of the measurements. Furthermore, the data measured fit accurately into well-defined physical laws and the constants of the equations expressing these laws give, for example, for comparison or reproduction, a full and accurate description of the radiation tested.

3. The absorption of primary radiations, if homogeneous and not adulterated by secondary radiations, is governed by a definite mathematically formulated law known as the exponential absorption law for homogeneous radiations. In the sense of this criterion the absorption data of a homogeneous radiation, when no scattered or longer wave length rays are contained in it, should, if plotted on semi-logarithmic paper, give the plot of a straight line; but if the radiation is not homogeneous the plot is a bent curve.

4. This new instrument is so designed that the plot of absorption data, if the radiation is homogeneous, gives a straight line when plotted on semi-logarithmic paper, and thus when a straight line plot is obtained it is also proof that no errors or inaccuracies are present.¹

5. The instrument consists of an electroscopical unit in such relation with an ionization chamber and so shielded with lead that natural leakage is practically absent or negligible. The ionization chamber is so constructed that no other than primary rays can enter it. (Fig. 1.) Its use consists in plotting the absorption data obtained with increasing thicknesses of sheets of pure

¹The homogeneity referred to is not absolute homogeneity in the strict physical sense, but *absorption homogeneity* in the sense in which the rays are employed in deep roentgen-ray therapy. Physically defined, absorption homogeneity indicates that the absorption coefficient is constant or that the percentage loss by absorption in every additional uniform absorption thickness is constant.

copper on semi-logarithmic paper, and from the plot the various data required for therapy are then read off.

It required extensive experimenting to develop the details of construction of this instrument so that it would comply with the requirements indicated or so that the data measured are sufficiently accurate and well enough defined to fit into the theoretical equations.

6. Before a radiation can be employed for roentgen therapy there should have been determined and there should be known:

(a) The filter thickness required to produce practical or absorption homogeneity.² The correct thickness of copper as a filter is indicated by the point where the plot of the absorption data commences to be a straight line.

(b) The average wave length of the radiation or its absorption coefficient in water or protoplasmic tissue.³ It is obtained by taking two points of the straight part of the absorption curve as many divisions apart as correspond to 1 mm. of copper, dividing the smaller into the larger, and then with this I_0/I_x coefficient as ordinate the average wave length or the absorption coefficient of the desired material as abscissæ is read from curves.⁴ (See Fig. 3.)

(c) The fraction of the radiation passing through the filter as compared with the fraction absorbed in the filter. At the abscissa corresponding to the filter thickness employed the percentage of transmitted radiation is read from the plot. For voltages between 180–230 kilovolts, if the percentage transmitted is divided into a constant 6,800–9,200 at 50 cm. distance according to the degree of skin reaction desired (i.e., 6,800 for a first degree reac-

tion or 9,000 for a third degree reaction), this gives the useful "milliampere-minutes," or fully useful radiation acting upon the skin.⁵ (See Fig. 2.)

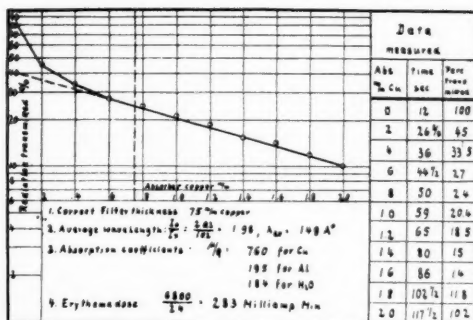


Fig. 2. The table at the right gives a set of readings obtained with a highly efficient machine at about 225 K. V. In the central column is given the time in which the electroscope discharged and in the third column are given the transmitted percentages for the absorber thicknesses given in the first column. The curve is a plot of these transmitted radiation intensities on logarithmic cross section paper and the lower table gives the data obtained from the curve with the aid of tables or curves such as those plotted in Fig. 3.

⁴The curves are plotted from equations which are derived as follows:

Given the law of absorption which holds only for homogeneous radiations.

$$I_x = I_0 e^{-\frac{\mu}{\Sigma} X} \quad \text{we obtain from it}$$

$$\log \frac{I_0}{I_x} = \frac{\mu}{\Sigma} X$$

The mass absorption coefficients are related to the wave length as—

$$\frac{\mu}{\Sigma} = 193 \lambda^3 + .13 \quad \text{for copper}$$

$$\text{and } \frac{\mu}{\Sigma} = 15.5 \lambda^3 + .147 \quad \text{for aluminum}$$

(Data of Duane and Richtmyer)

From these we obtain by substitution and rearrangement for the average wave lengths,

$$\lambda_{av} = \sqrt[3]{\frac{\log \frac{I_0}{I_x} - .05}{74.77}} \quad \text{for copper}$$

$$\text{and } \lambda_{av} = \sqrt[3]{\frac{\log \frac{I_0}{I_x} - .017}{1.82}} \quad \text{for aluminum}$$

For the mass absorption coefficients we obtain—

$$\frac{\mu}{\Sigma} = 2.58 \log \frac{I_0}{I_x} \quad \text{for copper}$$

$$\text{and } \frac{\mu}{\Sigma} = 8.55 \log \frac{I_0}{I_x} \quad \text{for aluminum}$$

²A filter thicker than that which produces absorption homogeneity cannot further improve the quality of the radiation to any useful extent, but only prolongs the time of treatment.

³The average wave length is the wave length of a radiation that is equivalent and equally absorbed as the radiation tested, but which is "homogeneous" to such an extent that its absorption coefficient or absorption ratio does not change noticeably with various filter thicknesses. The minimum wave length can be calculated with the quantum relation from the voltage, but as it has only a very small X-ray intensity, and the minimum wave length is not in any direct or known way related to the average wave length, therefore to know the minimum wave length is of no practical value for roentgen therapy.

7. Absorption curves obtained with this instrument also express as a numerical value the efficiency and adjustment of the machine employed. By extrapolating or continuing the straight line plot back to

given amount of energy passing through the tube.

8. There are found in practice a number of unexplained peculiarities. One of these may be of particular interest insofar

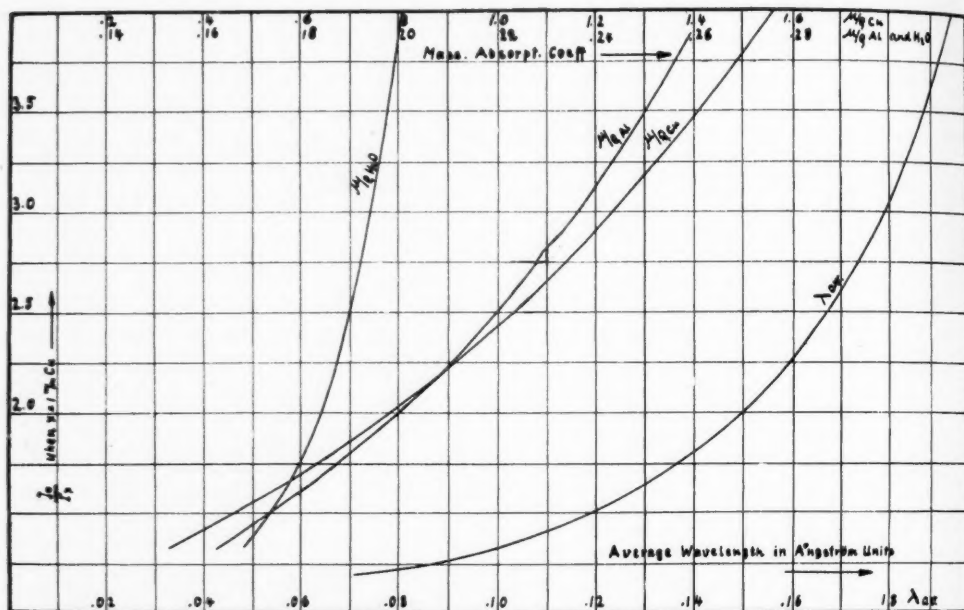


Fig. 3. The curve on the right is plotted from the equation given in Footnote 4. After the transmission intensities are read off from the curve of Fig. 2 at 1 m/m and 2 m/m copper, the larger is divided into the smaller and this is the value I_0/I_x plotted as ordinate and λ is its abscissa. The absorption coefficients for copper, aluminum and water are read off from the same ordinates. With the aid of these, depth doses, etc., can be calculated. (Method will be published in the near future.)

the zero line the point of intersection expresses the efficiency of the machine and tube as to the percentage of useful rays produced. Moreover, if a thinner rather than a thicker filter can be shown to be sufficient to homogenize the radiation, and therefore a greater proportion of useful rays is transmitted through the filter, then it is also found that proportionally less time is required to obtain an erythema dose with a

as it can be explained with measurements made with this instrument. The time ratios for erythema doses obtained with different filter thicknesses were found to be as follows:

Filter m/m Cu.	$\frac{1}{2}$	$\frac{3}{4}$	1	$1\frac{1}{4}$	$1\frac{1}{2}$
Erythema dose ratio (Glasser) .....	.61	.81	1.00	1.19	1.38
Erythema dose (Ernst) .....	.66	.75	1.00	...	...
From absorption curves .....	.60	.82	1.00	1.20	1.42

The relatively shorter erythema dose time with the thin filters which, as the curves show, are not sufficient to fully "homogenize" the radiation is, therefore, due to the admixture of a softer, biologically more active ray component, as is indicated by the upward bent part of the absorption

⁵These constants have been found to hold in a great many cases where different types of apparatus were investigated. The erythema doses thus calculated were found to agree satisfactorily with biologically found erythema doses, provided that an X-ray tube is not employed which is very heavily blackened and that the absorption curves are made without any filter. Further checking of the constants, however, is being continued.

Naturally, there exists a fixed relation between this constant and the erythema dose expressed in "e" units. Work to determine the equivalence of this constant in "e" units is in progress and the results are expected to be ready for publication in the near future.

curve at the division for $1\frac{1}{2}$ mm. copper filter.

9. Practical tests thus far made show that if a reliable milliamperemeter is employed and the useful component part of the radiation passing through a filter is determined, that the biological effect of the rays is proportional to the numerical values obtained as above explained. In this measuring method, therefore, is eliminated the danger arising from not having any check as to the presence or absence of errors in the data measured, as well as the errors of maladjustment which are likely to arise when absolute or calibrated measuring instruments are employed.

10. Roentgen-ray radiation is completely described and defined by stating:

(a) The average wave length.

(b) The percentage of rays passing through the filter which is sufficient to homogenize it.

(c) The constant employed to calculate or to define the erythema dose.

These data then enable any other roentgenologist to reproduce a radiation with the same properties and the same physically measured dose, and thus the deep therapy work would undoubtedly become much better defined and standardized.

11. *Summary.* An instrument not requiring calibration is described for determining the factors *a*, *b*, *c* of Paragraph 10. It is shown that there is a visible check upon the accuracy of the results. The theory upon which this instrument is designed is briefly indicated and the derivation of the equation is given.

Parietal aneurism of the heart.—There are only about 120 cases of parietal aneurism of the heart reported in medical literature, the majority of the patients being over 40 years old. The condition is almost always an autopsy finding, only about six cases having been diagnosed during life, of which two were diagnosed by radioscopy. When the symptomatology of these lesions is made more clear, it is probable that it will be found more frequently in adults and perhaps even in children. The authors observed a case of parietal aneurism of the heart in a woman aged 27 years, which was diagnosed by radioscopy. The history showed pain in the precordial region and anemia. On examination, exquisite pain could be elicited on slight pressure over the fifth left intercostal space in the neighborhood of the sternum and in a very limited zone covering a surface of 3 cms. diameter. A souffle could be detected on auscultation. Radioscopy showed an aneurism very high in the left ventricle toward the auricular-ventricular septum which is not usually the site of election of aneurisms. Ordinarily an aneurism is situated at the apex and is confounded with the hepatic

shadow, which makes diagnosis by the screen difficult.

In this case the only rhythmic modification noted was an exaggerated acceleration on the slightest effort, but without arrhythmia, which is explainable by the situation of the lesion.

The symptom of exquisite pain in a clearly localized spot, noted in this case, was also noted in the majority of the other reported cases. It is a sharp, non-anginous pain without radiation. Whether due to a pericarditis or to myocardial irritability the authors think this pain is pathognomonic.

In the absence of any other morbid symptom in a patient whose heart is weak, when this exquisite pain on pressure is met, a parietal aneurism should be thought of and radioscopy indicated. Under the screen the hypothesis of "nervous palpitation" or "intercostal neuralgia," under which terms these conditions are commonly included, will be disposed of and the seriousness of the condition allotted to the suitable therapeutics.—*Parietal Aneurism of the Heart Diagnosed by Radioscopy (Anéurysme pariétal du cœur diagnostiqué par l'examen radioscopique).* Bergonié and Moulinier. *Arch. d'élect. méd.*, XXXI, 1923, p. 65.

THE HISTORY OF RADIUM¹

By KENNETH S. DAVIS, M.D., Fellow in Radiology, The Mayo Foundation, ROCHESTER, MINN.

THE discovery of radio-active substances followed close on the discovery of the X-rays, and was due partially to certain phenomena observed in a Crookes tube. When there is sufficient vacuum in the tube all of the glass on the cathode side becomes fluorescent, shining with a bright yellowish-green light. In 1895 Roentgen discovered that in this condition the tube emitted a radiation capable of penetrating flesh and many other substances opaque to light. He called these rays "X-rays," but they were later named "roentgen rays" in honor of their discoverer.

We now know that the roentgen rays were produced by the action of the cathode rays on the glass of the tube, but in 1896 Poincare, a French mathematician, advanced the hypothesis that the fluorescence in the tube might be the cause of the roentgen rays. From this, he reasoned that all fluorescent material, if sufficiently illuminated, would give off roentgen rays. Several scientists adopted this hypothesis as a basis for their work, among them Henri Becquerel, who was particularly qualified to carry on research of this character, since he had received special training from his father, Edmond Becquerel, one of the pioneers in the investigation of phosphorescence and fluorescence. Becquerel's starting point was wrong, since the fluorescence of uranium was entirely apart from the surprising phenomena that will be described. In fact it may be said that at the time of his investigations uranium was the only known fluorescent substance capable of producing these phenomena. His first experiment was relatively simple; he surrounded a photographic plate with black paper, placed on it a few crystals of uranium sulphate, exposed the whole to the sun, and after several hours developed the plate. A faint picture of the crystals appeared. Apparently the hypothesis had been demonstrated, and the fluorescence in

the uranium illuminated by sunlight had produced roentgen rays, since the black paper had been penetrated beneath the crystals. Becquerel, naturally, was very anxious to repeat the experiment, this time interposing between the plate and crystals not only the black paper, but a copper cross 0.1 mm. thick to see if the radiation of the uranium would penetrate through the denser obstacle. Fortunately for Becquerel the sun did not shine. After keeping the plate in the dark room underneath the crystals and cross for several days, waiting for the sun to appear, he became impatient and proceeded to develop the plate. To his great surprise a vivid picture appeared. The uranium, shielded from any kind of illumination, had given off energy without appreciable change in the substance itself. By repeating the experiment several times he effectively disproved Poincare's hypothesis, but it was still necessary to determine whether uranium possessed the property of some of the phosphorescent bodies of storing luminous radiation and giving the energy back more slowly, and in a changed form. If this were true, as time went on, the action would grow weaker and weaker if the uranium were kept in a dark room. However, repeated trials demonstrated that even after several months the activity of the uranium was not diminished in the slightest. The phenomenon of radio-activity and the fact of the spontaneity of the uranium radiations were thus definitely established, and the rays emitted were called "Becquerel rays" in honor of their discoverer. The report of Becquerel's work in 1896 stimulated many others to similar research, among whom should be mentioned Elster, Giesel and Schmidt of Germany, Kelvin and Crookes of England, and Rutherford of Canada.

At about this time Marie Sklodowska of Poland (afterward Madame Curie) was a student at the University of Paris, doing

¹Read before the Osler Medical Historical Society, Rochester, Minn., April, 1923.

graduate work in physics and chemistry under Becquerel and Curie. Becquerel, having the greatest respect for the accuracy of Miss Sklodowska's training and the precision and clarity of her mind, invited her to undertake the study and investigation of the Becquerel rays. Her problem in the beginning was relatively simple. She wanted "to demonstrate that radio-activity was present, not only in uranium, but in other elements as well." She hoped to find this property in other bodies, but to a lesser degree. First of all it was necessary to be able to measure accurately the radio-activity of the elements to be studied. A gold-leaf electroscope, therefore, was devised which was adaptable to her experiments. With this electroscope she conducted a systematic examination of various ores for evidence of radio-activity and found that the element thorium possessed radio-active properties of about the same degree as those of uranium. However, a short time before she published her thesis, Schmidt, of Germany, announced the discovery of radio-activity in the same metal. Undaunted by this, Madame Curie began the examination of uranium-bearing ores and also of uranium residues in order to determine their relative radio-activity as compared with uranium. Her first samples were from the mines in Joachimsthal, Bohemia, the source of the uranium which Becquerel had used in his experiments. The ore was known as pitchblende, and was a black mineral resembling hardened pitch in density and color. Chemically, it is a fairly pure oxid of uranium, although it is also known to contain many other elements in small quantities, such as lead, copper, bismuth and barium. At this time the ore was being mined for the uranium, as it contained as high as 50 per cent of this element. Madame Curie ground the ore into a dry powder, and on testing its radio-activity with her electroscope, found it to be several times as active as pure uranium, and in all cases the minerals tested showed from four to five times the activity to be

expected from the percentage of uranium present.

Becquerel had previously shown that the radio-activity of uranium was an atomic property; that is, the activity observed depended only on the amount of uranium present and was not affected by its combination with other substances. Thus, the great activity of the uranium ores could only be accounted for by assuming that another substance was present which was much more active than uranium itself. Madame Curie interested her husband in her work, and they joined forces in the attempt to isolate the unknown element. Through the courtesy of the Austrian Government they secured a ton of the same kind of uranium residue that Madame Curie had previously examined. Separating pitchblende into all its constituent parts is even now an extremely difficult task, and was particularly difficult for the Curies, who were searching for an unknown element, which, as is now known, occurs in the richest ores in proportion of about one to ten million. As a guide to the separation of the radio-active substance they employed Madame Curie's electroscope to measure the ionization produced by the active body. After each chemical separation, the activities of the precipitate and the filtrate, evaporated to dryness, were separately examined; in this manner it was possible to ascertain whether the active substance had been mainly precipitated or left behind in the filtrate. This served as a rapid means of qualitative and quantitative analysis. Only a general idea of the process of extraction will be given here.

The mineral was first heated with sodium carbonate, and then dissolved in hydrochloric acid, after which it was treated with hydrogen sulphid. A black, muddy precipitate was formed from the clear solution. On separating the precipitate into its constituents, which included copper, lead and bismuth, a certain amount of radio-activity was found to accompany the metal bismuth. A radio-active element, combined with the bismuth, was isolated and

called "polonium" in honor of Madame Curie's native country. Polonium is now designated "Radium F," since it is one of the decay products of radium. Ammonia was added to the clear solution and a new precipitate containing iron and uranium formed. This precipitate was, of course, radio-active due to the presence of uranium, but the filtrate, when tested, was many times more so. Ammonium sulphid was then added to the filtrate and a non-active precipitate obtained. Finally, ammonium carbonate was added to the remaining filtrate, and this precipitate, when tested, was found to be several times more active than the original pitchblende. When examined chemically, this precipitate was found to be made up chiefly of barium. Knowing pure barium to be absolutely inactive when tested with an electroscope, it was evident that the barium from the pitchblende contained another substance so similar in chemical properties that all the chemical operations the material had undergone thus far had failed to separate them. The final separation was accomplished by fractional crystallization, a prolonged, tedious process, this being the only method found so far that will successfully separate the two elements. The radio-active barium was converted into barium chlorid, the solution evaporated to dryness, and the crystals were dissolved in boiling water. The solution was allowed to cool, and the crystals which separated on cooling were collected, and found to be more radio-active than the material from which they were made. It was evident, therefore, that associated with the barium chlorid there was a radio-active metal allied to barium which formed a chlorid less soluble than barium chlorid. This new element was called "radium" in allusion to its radio-active properties. By working on large quantities of material and by repeated fractional crystallizations, they obtained products more and more active until they at last obtained a product thirty times as active as uranium. Surely this last product, even if not pure, must at least contain a large proportion of the new ele-

ment. A platinum wire was dipped into the salt and then into a Bunsen flame, and to the disappointment of the investigators, only the characteristic green color produced by barium was visible. However, when the light was analyzed spectroscopically, faint lines were present in addition to those produced by the barium. It was necessary then to persist in the crystallization. The product became more and more radio-active, and the red rays, characteristic of the new substance, began to predominate in the Bunsen flame. Finally, when the salt had been reduced to the merest pinch by the successive reductions at each separation, the spectral lines of barium could no longer be seen. Pure radium chlorid had at last been isolated at the expense of almost incredible labor and perseverance. The activity of the pure radium chlorid was amazing, even to its discoverers. The electroscope was discharged almost instantly, and a photographic plate was fogged merely by bringing it near the radium product. Its radio-activity was later found to be over two million times that of uranium.

It might be of interest to note here that radium itself was not obtained until 1910 (twelve years later), when Madame Curie and Debierne isolated the element as a pure white metal, resembling barium in its general chemical properties, and showing the radio-active properties expected. Its atomic weight, as determined by Madame Curie, was found to be 226.4. Metallic radium changes quickly when exposed to the air since it reacts with the water in the air, forming radium hydroxid.

The publication by the Curies of their thesis, in 1898, aroused great interest, and many able investigators began work on the newly discovered element. Within a few months Giesel had simplified the process of extraction, reducing the time required for fractional crystallization from three months to one month. He dissolved the radio-active barium obtained from pitchblende in hydrobromic instead of hydrochloric acid, producing the bromides of radium and

barium, which are much easier to separate by fractional crystallization. By this method Giesel succeeded in securing the largest quantity of radium bromid that has as yet been obtained from any ore (4 grains to the ton of residue). It was extracted from the pitchblende at Joachimsthal, Bohemia. Realizing the value of the radium-bearing ores in Bohemia, the Austrian Government forbade its exportation, and a world-wide hunt for radium ores was begun immediately by the French and English. Radium was found to be widely distributed throughout the earth's crust in minute quantities. Strutt, Joly, Knocke and others were able to detect it in very small quantities in volcanic rocks, in certain springs and in sea water.

Pitchblende, or uranite, was found at Cornwall, England, but in such quantities as to be of negligible value. In 1899 two French mineralogists, in search of pitchblende, came to America, where they found immense deposits of a uranium-bearing ore in Colorado and Utah. They called this ore "carnotite," in honor of Carnot, a French chemist. On analysis this ore was found to contain radium, but in considerably smaller quantities than in pitchblende. Nevertheless, since its discovery this deposit has produced over 80 per cent of all the radium in use to-day. The production of radium for the next fourteen years was on a very limited scale, as can be seen from a bulletin issued by the Bureau of Mines, Washington, D. C., in 1913, announcing that, of the estimated world's supply of radium (about 30 gm.), enough ore had been shipped to Europe from the United States to manufacture 18 gm., and that, despite this large exportation, less than 2 gm. was owned in this country.

However, shortly before this report was made, Mr. Joseph M. Flannery, the pioneer producer of Vanadium Steel and the head of the American Vanadium Steel Company, became interested in radium through the death of a sister from carcinoma. He learned that radium might have helped her, and determined to make enough of the ele-

ment in this country so that it would be available in all similar cases. He withdrew from his vanadium and other interests, devoting all his time to this task. After fourteen months of preliminary work and experimentation he succeeded in extracting the first radium in this country in 1913. The field was absolutely new and unknown to anyone in America. The process of extraction was entirely different from that used in Europe, where the ores were about one hundred times as rich in radium.

The carnotite deposits which he had selected for his ore supply were located in southwestern Colorado, sixty-five miles from a railroad and in a dry, arid country. A concentration mill and supply depot were built at a point convenient to the many ore claims, as the deposits covered a region of about 800 square miles. Burros were used to carry the ore from the mines in the mountains, and to carry back to the miners the water and other supplies, for all of which they were dependent on headquarters.

Since the extraction of the first radium in 1913 the United States has become the foremost producer of radium in the world, and in 1922, out of a total of 175 gm., estimated to be the world's total available supply at this time, had produced about 120 gm. The process of radium production in this country is approximately as follows: The carnotite ore is reduced to a fine powder and sacked at the concentration mill. These sacks are transported by burros, wagons, and trucks to the railroad, and shipped to the reducing plant, where the ore is refined, using nearly the same process as did Madame Curie when she first isolated the element, but on a much larger scale. About 500 tons of the powdered ore are reduced to 500 pounds of radium barium chlorid. It is then sent to the laboratory, converted into bromids, and separated by fractional crystallization. The production of 1 gm. of radium from the carnotite ores requires from 500 to 600 tons of ore, 10,000 tons of distilled water, 1,000 tons of

coal, and 500 tons of chemicals. Practically all of the radium as made to-day is in the form of salts, of which radium bromid, chlorid, and sulphate constitute the bulk. The bromids and chlorids are soluble in water and are used chiefly in the preparation of radium emanation, whereas the insoluble radium sulphate is used mainly in the making of the various therapeutic applicators.

Recently radium has appeared on the market which has been extracted from an ore located in the Belgian Kongo, Africa. The ore had been discovered just before the Great War by a Belgian firm engaged in copper mining, but fearing an unfavorable outcome of the war they kept their discovery a secret. Only within the past year has the ore been mined on an extensive scale. It consists largely of pitchblende similar to that found in Bohemia. The ore is shipped to Belgium, where the radium is extracted. As a direct result of this, the price of radium fell from \$120,000 to \$70,000 a gram, and some of the American mines are temporarily closed, being unable to compete with a company having a richer grade of ore. It is not known as yet how much radium the newly found deposits will eventually yield.

THE DISCOVERY AND THE UTILIZATION OF THE PHYSICAL AND CHEMICAL PROPERTIES OF RADIUM

The development of the theory of ionization of gases by Wilson, Thompson, Rutherford and Townsend (1896-1899) proved of great value, not only in the isolation of radium, but also in the study of its radio-active properties. In 1899, as a result of the work of Giesel, Becquerel and Villard, the alpha, beta and gamma rays of radium were separated and studied. The alpha rays were found to be positively charged helium atoms shot out from the radium atom with a velocity of from 9,000 to 12,000 miles a second. They are not penetrating, and, in fact, can be stopped by a single sheet of paper. Later Madame Curie was able to demonstrate that they were the

principal source of the heat emitted by radium; "thus out of a total of 136 calories, given off by a gram of radium in one hour, the alpha rays are responsible for 125 calories." The beta rays were shown to be similar to, or identical with, the cathode rays of an X-ray tube; in other words, they are negatively charged particles (electrons) traveling at a high velocity and able to penetrate from 1 to 5 mm. of aluminum, depending on their speed. More recently their velocity has been measured and found to vary from 2 to 98 per cent of the velocity of light. The gamma rays were shown to be non-electrified radiations, corresponding to the X-rays, but more penetrating. Unlike the alpha and beta rays, they cannot be deflected by a magnet and are neither refracted nor reflected. They possess ionizing, photographic and fluorescent properties, but to a lesser degree than the alpha and beta rays, the proportion being, alpha rays 10,000, beta rays 100, and gamma rays 1. However, they compensate for this by their penetrability. Recently they were detected by Failla, of New York City, behind 25 cm. of lead, although as a rule 10 cm. of lead will stop more than 99 per cent of these rays. As a comparison between the gamma rays of radium and the X-rays it has been estimated that it would require an X-ray machine of two million volts to produce X-rays as penetrating as the shortest gamma rays. In the same year that Giesel, Becquerel and Villard were carrying on this work, Rutherford demonstrated that thorium emitted a gaseous radio-active substance which he called "thorium emanation." This gas was found to have the power of ionizing gases and of affecting photographic plates. When separated from the thorium compounds the emanation was found to lose its radio-activity rapidly. Shortly after this Madame Curie demonstrated that all bodies placed in the immediate neighborhood of radium become temporarily radio-active. It was later discovered by Dorn (1901) that this induced activity is due to radio-active substances, deposited on the object by a gas, given off

by the radium. By analogy, this gas was called "radium emanation," since in many respects it resembles the thorium emanation, particularly in its properties of radio-activity, and in the fact that it behaves chemically as an inert, unstable gas of high molecular weight.

The phenomena of the thorium and radium emanations, and their radio-active deposits, led Rutherford and Soddy to advance their theory of the atomic disintegration of radio-active substances, which is universally accepted to-day. "Radio-activity is the direct result of a spontaneous process of atomic transformation. This process goes on at a regular rate for each radio-active substance and is accompanied by the emission of alpha, beta or gamma rays and the production of new forms of matter, these new elements also transforming until finally a stable atomic form is reached. This disintegration cannot be altered or hastened by any known chemical or physical means." In the disintegration of radium it is broken down to form radium emanation, giving off at the same time ionized helium atoms commonly known as "alpha particles." The radium emanation atoms are very unstable and decay rapidly, forming atoms of a solid body known as "Radium A," at the same time giving off alpha particles. Radium A is a very quickly changing body: at the end of three minutes its atoms are reduced to one-half of the original number, being transformed into the atoms of another body, Radium B, after the emission of alpha particles. This substance has a half value period of twenty-six minutes, emits beta and gamma rays and is transformed into Radium C. Radium C has a half value period of nineteen minutes and emits alpha, beta and gamma rays in changing to Radium D. Radium D is a comparatively inactive body having an estimated half value period of sixteen and one-half years, becoming Radium E after the emission of beta rays. Radium E has a half value period of five days and gives off beta rays, becoming Radium F, origi-

nally known as polonium. Polonium has a half decay period of 136 days, emitting alpha particles in changing to the end product of the series, Radium G, a substance chemically indistinguishable from lead, but having an atomic weight of 206 while the atomic weight of ordinary lead is 207.1. The rate of loss of radio-activity of radium is spoken of in terms of the half decay or half value period, and means the reduction of the radium atoms to one-half their former number by decay, this being accompanied, of course, by a loss of one-half of its original radio-activity. This period has been estimated as being 1,680 years, and at this rate the loss of activity in 100 years is about 3 per cent. The half value period of radium emanation is three and eighty-five hundredths days, and at the end of thirty days all but half of 1 per cent of a given quantity of radium emanation will have decayed. However, the rate of growth of radium emanation from radium is directly in proportion to the rate of decay of the emanation, so that the emanation is kept at a constant equilibrium with the radium. It should be noted that the studies of the remarkable properties of radium by Rutherford, Soddy, Becquerel, Giesel, Dorn, Madame Curie, and others have compelled the revision of previously existing ideas regarding the composition of matter, especially with regard to the relation of electricity to matter and the structure of the molecule and the atom.

The effects produced by the action of the radium rays on the skin were first recorded by Walkoff in 1900, and shortly afterward Giesel described an experiment in which, after a two-hour exposure by 0.2 gm. of a radium preparation, there was an intense reaction with pigmentation after two or three weeks, followed by vesiculation and scabbing. After healing, the hair did not grow on the rayed spot. However, radium treatment did not receive its initial impetus until after the famous "Becquerel burn" in 1901. Becquerel placed a tube of very active radium in the pocket of his waistcoat, where it remained for several hours.

Two weeks later a severe inflammation of the skin appeared which was attributed to the action of the radium. Curie then made an experiment on himself and, as a result of the discovery of the new property of radium, loaned a specimen to Danlos, of the St. Louis Hospital, Paris, for medical purposes. In the same year Danlos reported on the treatment of lupus erythematosus by the use of radium chlorid. As rapidly as the amounts of radium available permitted, experiments in its use were made by other workers in Europe and America. Probably the first American to suggest radium as a therapeutic agent was Rollins, a physicist of Boston, who had previously been much interested in the development of the X-ray. In 1900 Rollins gave Williams, also of Boston, a small metal box with an aluminum front, containing 500 mg. of a radium preparation with a strength of 1,000 (1,000 times as radio-active as uranium) for use as a therapeutic agent. Williams used this radium in the treatment of rodent ulcer and lupus, but the preparation was found to be too weak to compare favorably with the X-rays and was abandoned temporarily. In 1903 Williams went abroad, where he obtained 100 mg. of pure radium bromid and a large amount of radium of less radio-activity, and on his return founded a radium clinic at the Boston City Hospital. The same year Sowers, of New York City, received a very interesting letter from Alexander Graham Bell, inventor of the telephone, which he published in the August number of the *American Magazine*, in the hope, no doubt, that it would stimulate certain physicians to follow its suggestions. This letter seems worthy of reproduction in full:

"DEAR DR. SOWERS:

I understand from you that the roentgen rays and the rays emitted by radium have been found to have a marked curative effect on external cancers, but that the effects upon deep-seated cancers have not thus far proved satisfactory. It has occurred to me that one reason for the unsatisfactory nature of these latter experiments arises from the fact that the rays have been applied externally, thus having to pass through healthy

tissues of various depths in order to reach the cancerous matter.

The Crookes tube from which the roentgen rays are emitted is, of course, too bulky to be admitted into the middle of a massive cancer, but there is no reason why a tiny fragment of radium sealed up in a fine glass tube should not be inserted into the very heart of a cancer, thus acting directly upon the diseased material. Would it not be worth while making experiments along this line?

(Signed) ALEXANDER GRAHAM BELL."

Although Rollins was no doubt the first American to suggest the use of radium as a therapeutic agent, Abbe, of New York City, was the first American physician to use it with any degree of success. His first article, "Radium and Radio-activity," was published in 1904. In his second article, "The Subtle Power of Radium," he says: "It gives me pleasure to put on record such observations as I have been able to make during fifteen months, with the best radium made by the laboratory of the Curies in Paris. I was able, by cabling a very early order, to get 15 centigrams (2.25 grains) of the strength 300,000, which was part of the larger amount used by them in their experiments for calorimetric determinations (now historic). With this and other strong specimens, including one of German manufacture, denominated a million activity, I have been able to verify most of the interesting work of the foreign observers and to add some of my own."

The pioneers in Europe were Lazarus, Mache, Szilard, Danlos, Wickham and Degrais, Bashford, Becquerel, Czerny, Freund, Bayet, Schiff and others, while in this country, besides the workers named, should be mentioned Hammer, Cleaves, King, Morton, Duane, Kunz, Robarts, Trowbridge, Metzenbaum, Pegram, Piffard, Pusey, Tracy, and Winkler.

THE FIRST TREATMENT OF DISEASES BY RADIUM

Cutaneous cancer, lupus vulgaris, lupus erythematosus, psoriasis and port wine stasis (Danlos) 1902
Leukoplakia (Rehns and Salmon) . . . 1904

Keloids (Williams, Werner and Herschell)	1904
Eczema (Lassar)	1904
Warts (Abbe and Bockoff)	1904
Pigmented nevi (Hartigan)	1904
Cancer of breast (Lassar and Abbe) ..	1904
Xanthoma (Barcat and Bond)	1905
Sarcoma (Morton)	1905
Cancer of the cervix (Abbe)	1905
Fibroids (Abbe)	1905
Exophthalmic goiter (Abbe)	1905
Eczema (Blaschke)	1905
Sycosis, acne rosacea, lichen ruber (Blaschke)	1905
Angiomas (Wickham and Degrais) ..	1906
Eczema (Wickham and Degrais)	1906
Epithelioma of mucous surface of lips, tongue and mouth (Abbe, Dominici)	1908
Rhynophyma (Wickham and Degrais)	1909

During the first ten years of its development, radium therapy struggled with two great difficulties. These were the small amounts of radium available for the work, and the lack of a suitably accurate method for standardizing the preparation of radium for therapeutic use. To secure greater accuracy, the Congress of Radiology and Electricity, meeting in Brussels, asked Madame Curie to prepare a standard. This consisted of 21.99 mg. of pure radium chlorid sealed in a thin glass tube. In March, 1912, this standard was accepted as the International Radium Standard and is preserved at the International Bureau of Weights and Measures at Sèvres, near Paris. Duplications of the standard have been prepared by the governments of the world, that for the United States being in the possession of the United States Bureau of Standards, at Washington, D. C. Up to this time, as has been noted, the radioactivity of radium was determined by comparison with uranium. Thus, if the preparation was said to have a "strength of 1,000," its radio-activity was 1,000 times that of uranium. There then came into general use the gamma ray method of comparing quantities of radium; this was one

of the most important of the advances made towards standardization of radium therapeutics. The process is relatively simple; the alpha and beta rays are screened off and the ionizing power of the gamma rays is measured on a gold-leaf electroscope. All radium sold in this country is now compared with the radium standard in Washington, D. C., by the gamma ray method over a period of thirty days, and the amount graded accordingly.

Danlos' crude applicators were modified by later workers, some of which are in use to-day. The varnish-surface plaques were introduced by Danne, and the metal tubes filled with radium salt are generally credited to Dominici, although I believe this idea originated with Alexander Graham Bell. Later these tubes were made with sharpened points to aid in the introduction into tumors. Dominici first showed the importance of suitable filters to absorb the irritating soft alpha and beta rays when treating tumors requiring considerable radiation.

Radium emanation in tubes or applicators instead of radium itself as a source of therapeutic radiations appears to have been used first in 1912 by the London Radium Institute. It had been known for some time that the best way to obtain the emanation from radium is to dissolve the preparation in water or dilute hydrochloric acid and connect the containing vessel to an ordinary mercury displacement pump where the emanation, as it is formed, can be easily collected over mercury. A solution of a radium salt when pumped off in this manner immediately begins to produce more emanation, which collects until an equilibrium value is reached corresponding to the quantity of radium present. The amount of emanation in equilibrium with 1 gm. of radium was found to be a definite quantity, and it is now known as the *curie*, in honor of the discoverer of radium. This quantity is very large for most purposes and the terms *millicurie* and *microcurie* have come into general use for quantities of emanation corresponding to 1 mg. and 0.001 mg. of radium, respectively. When

one considers the radio-active deposits of the radium emanation, it is not surprising to find that, when the gas is separated from radium and sealed in a glass tube, in three hours' time the radiation produced by the emanation is the same as if the tube had been filled with radium itself. However, such tubes gradually diminish in intensity, the duration of the tube being about thirty days, beyond which its radio-activity is so reduced in value as to be useless for therapeutic purposes. Needless to say, the emanation plant as first used by the London Radium Institute has had many modifications and improvements, and at present more than 90 per cent of the total emanation given off the radium can be collected and utilized. Emanation, although employed by many of the larger clinics and institutions, is not in common use, since it requires not less than 0.5 gm. of radium chlorid or bromid before the emanation will be given off in sufficient quantities to be utilized economically.

In 1912 a number of institutes were carrying on radium treatments extensively, the most important in point of experience probably being the Laboratoire Biologique du Radium, in Paris, under the direction of Wickham and Degrais. Next in importance was the Hospital St. Louis, Paris, with Dominici, and there were also radium institutes at Heidelberg, Vienna and London. In 1913 the medical world was thrilled by the reports given at the Gynecologic Congress at Halle when Kroenig, Gauss, Bumm, and Döderlein reported their astonishing results obtained by the use of massive doses of gamma rays, from heavily screened mesothorium preparations, in the treatment of carcinoma of the cervix uteri. A "radium fever," as it was called, spread over Europe and the production of radium could not begin to meet the demand. While harmful at the time, this propaganda really accomplished considerable good, as it encouraged many of the better hospitals and institutions to purchase large amounts of the element, which were placed under the control of conscientious and scientific observers. In the United

States, radium therapy, while it was accepted, was not established as an important branch of therapeutics until after the beginning of the Great War with its upsetting of communications with Europe. This, and the fact that the bulk of the radium was being produced in the United States, gave a great impetus to its utilization, and now more than twice the amount of radium is being used for therapeutic purposes in this country as in the rest of the world. I shall not attempt to describe in detail the points in the development of radium therapy since 1912. Suffice to say that rational, steady progress has been made, even though the results do not reach the exaggerated reports of the earlier writers.

Intelligent understanding of the limitations of radium treatment, and the co-operation of the surgeon, the roentgenologist and the radiologist, have gone far to improve results; and combined methods rather than reliance on a single means, give hope that radium treatment is now on a safe and sane foundation.

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EDITORIAL

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MID-ANNUAL MEETING

Chicago, Illinois, June 6 and 7.

Headquarters: Sherman Hotel

LOCAL COMMITTEE

Dr. I. H. Trostler, Chairman

Dr. M. E. Hanks Dr. M. J. Hubeny
Dr. B. C. Cushway Dr. B. H. Orndoff

THE ANNUAL MEETING

The next Annual Meeting of the Society is to be held December 8 to 12 inclusive at Kansas City, Missouri. Headquarters will be at the Muehlbach Hotel.

LOCAL COMMITTEE

Dr. E. H. Skinner, Chairman

Hospitality—Dr. O. H. McCandless, Dr. W. W. Duke.

Scientific Exhibits—Dr. Clyde Donaldson, Dr. Ira H. Lockwood.

Commercial Exhibits—Dr. L. C. Allen, Dr. David S. Dann.

Hall Committee—Dr. E. R. DeWeese, Dr. J. T. Swanson.

Hotel Committee—Drs. E. B. Knerr, W. T. McDougall, and Chas. E. Virden.

Hospital Clinical Committee—Dr. L. A. Marty, Dr. J. L. McDermott.

Liaison Committee—Dr. Geo. Knappenberger.

Publicity Committee—Dr. Geo. Knappenberger.

INTERNAL MEDICINE AND ROENTGENOLOGY¹

Medicine progresses as science in general advances. One of the major functions of medicine is to appropriate unto itself the discoveries of science so far as they are applicable. According to the Father of Medicine, diet was the center about which the art developed. Celsus, writing in the days of Christ, tells us that even in his day it had become "more than a conjectural art." As science has evolved, it has permeated every phase of practice. At present

our profession is held in great honor, hybrid though it is, because it partakes of the best features of both the arts and the sciences.

Throughout the centuries internal medicine has continued to occupy the central position, sharing honors with surgery, which, at times, threatens to overshadow it. One division or specialty after another has developed. Some of them have proved fundamental to the science of medicine and may be considered the roots, while others are essential to practice and may be regarded as branches. But each successive specialty, root or branch, has found its logical place and abundant opportunity to expand, while medicine itself has flourished and grown along with them.

Within the span of a single generation, a great new specialty, roentgenology, has evolved. The observations and investigations of Roentgen opened up a tremendous field for practical service. The present exalted position of this specialty is the outcome of one of the most rapid evolutions ever experienced in medicine. The attitude of mankind in general toward such medical developments is most interesting. The world appreciates good practice, but looks on the investigator as visionary and impractical. It fails to appreciate completely the relation of the practice of the present to the investigations of the past. In reality, roentgenology constitutes one of the most striking examples of the value of investigation to medicine. Figuratively speaking, the practice of this specialty to-day rests on investigations of but yesterday. Since its origin and development rest so largely on investigation, further work of this type would appear highly desirable. Roentgenologists should, therefore, have a warm place in their hearts for investigation, and also a place in their laboratories for the investigator. In all probability, research

¹Read before the Radiological Society of North America, Rochester, Minnesota, December 3 to 7, 1923.

will prove as important to the future development of roentgenology as it has to its past development.

Of our five senses, the most reliable is sight. Vision breeds confidence. The roentgen ray increases the capacity to visualize and permits the unseen to be seen. This assures the roentgen ray a place in the fold of internal medicine. It should, at least, if we accept the distinction between the physician and surgeon made by Actinus of Lesbos, the first Greek poet of whom we have definite knowledge. More than seven hundred years B. C. he relates how Esculapius, "endowed one of his sons with nobler gifts than the other; for while to the one, Machaon, he gave skilled hands to draw out darts, make incisions and heal sores and wounds, in the heart of the other, Podilarius, he placed all cunning to find out things invisible and cure that which heals not."

Roentgenology is a science of images or shadows. Images afford accurate evidence of existing conditions. The fact that roentgen-ray evidence is visual in character is of untold importance. In fact, it is responsible largely for the intense interest of the internist in X-ray work, for his constant visits to the X-ray laboratories, and for his continued presence in the field of roentgenology. Roentgen-ray evidence, being visual in character, possesses certain attributes which make it of peculiar value.

Psychologically, visualization compels interest. The clinician is very human. In common with the rest of mankind, he likes to visualize. He prefers to see his evidence.

Roentgenology offers still other advantages. It permits of demonstration. The patient can be shown the lesion, whereupon he also can appreciate the situation. Roentgen-ray findings frequently have a qualitative value. They may be pathognomonic in character, indicating the nature of the disease process. They also have quantitative value, revealing the extent of the lesion or lesions. Furthermore, they are subject to permanent record, thereby admitting accurate comparisons so important in fol-

lowing the course of disease. They are localizing, whereby they orient the clinician and admit of subsequent re-examination, a high power study of the system or parts concerned. The methods of roentgenology are refined and often bring to light early lesions unsuspected by the physician. In fact, the roentgen-ray findings may constitute the sole available evidence of the presence of lesions or of disease in its early stage. Every negative finding is of great importance in the exclusion of disease. While positive evidence breeds confidence, negative findings tend to conservatism in treatment.

The screen offers even greater advantage. By its aid, organs may be seen in the actual performance of their functions, and perversions of function incident to disease may be studied. Further, it furnishes valuable information relative to the localization, size, contour, movements and density of the organ as compared with normal, as well as the more specific data relating to the lesion itself. Palpation of the area and change of posture often add considerably to the evidence.

These attributes of roentgen-ray findings constitute some of the more cogent reasons for the constant presence of the clinician in the field of roentgenology. One look is as good as a page of description; words are an inadequate substitute for a picture.

Now, let us return to the relation of the internist and the roentgenologist to each other, and to the practice of medicine. The art of medicine is best exemplified in the daily work of the general practitioner. He, as a rule, uses only standardized methods, what we might speak of as approved science. He bothers but little with what he calls "frills" and the more recent developments. He treats all types of cases and refers patients freely when more expert judgment is indicated. The internist, on the other hand, devotes his attention exclusively to medical diagnosis and treatment, as a rule, limiting his field further by excluding patients who have not reached adolescence. His function is that of expert

diagnostician, clinician, and general consultant. The roentgenologist is usually a specialist or a special consultant with a reference practice, contributed to by all branches of medicine. "The day is long past when he should be nothing but a technician." Unless the roentgenologist can qualify as a consultant he is not worthy of the title of roentgenologist.

Diagnostically, the function of the internist is to assemble, appraise, and correlate evidence in the making of a diagnosis. In his investigation he determines what X-ray studies are indicated. In order to diagnose the case properly he must be capable of verifying the findings and of understanding the significance of all the evidence. In so doing, he must appraise the roentgenologist as well as his work, appraise the specialist as well as the specialty. Thereby he becomes an adept in the selection of sources of evidence. The roentgenologist's function is to visualize, demonstrate, and record evidence and to interpret its significance. The ultimate diagnosis is made by the internist through the correlation of evidence from all sources. Not infrequently, however, the roentgen-ray findings are in themselves sufficiently pathognomonic to admit of diagnosis. Under such conditions, and such conditions only, is a positive diagnosis by the roentgenologist justifiable. When the lesion is in any way atypical it should be so designated. Even when the roentgen-ray evidence is characteristic the ultimate diagnosis must be made by the clinician. The roentgenogram may reveal but a part of the evidence and other lesions may exist. The clinician's responsibility includes a comprehensive study leading to diagnosis.

In the field of treatment, the clinician determines the measures to be employed and directs their application. In suitable cases, the roentgenologist participates and brings to the patient superior knowledge in matters pertaining to types of treatment, dosage, methods of application, and so forth.

The question is frequently asked, "Has the internist any right to continue work in

roentgenology?" Since this constitutes one of the most important fields of diagnosis and treatment and is involved in the question of service to the sick, the clinician is well within his rights in continuing. However, the extent to which he should work is another matter and depends on the exigencies of the individual case, questions of training, environment, hospital affiliation, and so forth. It stands to reason that the clinician must be familiar to some extent with the roentgen-ray findings and their interpretation, if he is to be a good internist.

Aside from the very nature of the evidence itself, there are many excellent reasons why certain clinicians continue to participate to a very considerable extent in the field of roentgenology. The subject is young. Some clinicians have been interested in it from its very beginning, have grown up with it, so to speak. They have brought to it breadth of vision, knowledge of special needs in medicine, an intensive interest in certain special problems, and not infrequently they have made contributions of unquestionable value. Some of them, roentgenologists themselves regard as competent. This group will remain ingrafted, at least throughout the span of this generation. Other workers have entered roentgenology from medicine, surgery or some other special branch, because it is essential to their special fields. This is true of urologists, neurologists, thoracic specialists, and gastro-enterologists. Technical procedures have compelled certain physicians to take up some phases of the work, for instance, pyelography and ventriculography. Still others have been forced to take up roentgenology, themselves, because of lack of suitable service in their territory.

From a general point of view, the law of supply and demand controls the situation. As a specialty excels, it prospers. So long as the internist is capable of doing good work he will continue to do it. To the degree that the roentgenologist excels, he will do increasingly more and more. As the field of roentgenology develops, the internist will participate less and less, and

the specialist more and more. The field is already so large, the technical difficulties so great, that the young internist has real difficulty in gaining a foothold.

In medicine, the caliber of the man rather than his specialty determines the quality of service rendered. Whether the patient receives good service depends largely on the judgment he exercises in his original selection of a physician. A good physician will recognize his own limitations and call in expert advice when it is needed. A poor physician probably will either fail to recognize the need of roentgen-ray studies, will do his own roentgen-ray work, or call in inexperienced counsel. In any case, the patient is, vulgarly speaking, "out of luck."

This brings us to the consideration of the education and training of the roentgenologist. In the medical school curricula, roentgenology falls at times in the department of medicine, at times in the department of surgery, while at other times it constitutes an independent department of its own. With the evolution it has experienced and the position it has attained, it is, to my mind, as worthy of recognition as an independent department as any other great specialty. Where the personnel is right, it should have its own chair. High standards should be maintained. At present, the requirements are not definitely set. In the report of Investigations of the Council of Medical Education of the American Medical Association concerning the training of the specialist, the requirements for the department of roentgenology were not considered. This was a serious oversight. It is one of the functions of the roentgenologists to determine the standards and to see that they are attained and maintained.

In the Mayo Foundation the M.S. degree is given in roentgenology, the requirement being three years of graduate work, of which six to twelve months may be spent in fundamental branches, preferably anatomy, physiology, and pathology. Certainly, less than three years is inadequate to render a recent graduate competent in all fields of roentgenology. Internal medicine consti-

tutes a splendid preliminary training. Roentgenologists would do well to proselyte among young clinicians. Since it takes at least three years for a physician to make himself proficient in roentgenology, it is obvious that the average physician is not competent in this field and that in all but simple questions the services of the expert are desirable.

In diagnosis, treatment and investigation, the fields of roentgenology and internal medicine come in close contact. The development of the roentgenologist has been contributed to by the internist, the surgeon, the specialists in various fields, and especially by investigators in all the fundamental and special branches,—in other words, progress is the result of teamwork. The roentgenologist should welcome the research worker from all other branches of medicine and of science, and as a master of technic should co-operate fully and freely with all who are willing to work in roentgenology. For the development of medicine the roentgenologist should stand ready to welcome workers in other branches, or should accept as one of his functions the training of fellow practitioners in matters pertaining to the roentgen ray. Only by continued teamwork will the greatest progress be attained for internal medicine and for roentgenology.

LEONARD G. ROWNTREE, M.D.

DR. R. WALTER MILLS

OCT. 29, 1877—FEB. 16, 1924

From the ranks of Radiology another of the real leaders has passed away. Actively engaged in research and practice, almost to the day of his death, Dr. Mills followed the pace inaugurated early in his medical career, the fruits of which have demanded the recognition and respect of his confrères throughout the world.

He was born in Webster Groves, a suburb of St. Louis, on October 29, 1877. His public school education was received at Webster Groves and his college preparatory work for medicine at the University of Illi-

nois. In 1899 he received from the University of Illinois the degree of Bachelor of Science. His medical degree was received in 1902 from the St. Louis University School of Medicine (formerly Marion Sims Medical College). After completing his internship at the Alexian Brothers Hospital, St. Louis, he entered the practice of general medicine in St. Louis and Webster Groves. He married Miss Irene M. Goodberlet, of St. Louis, August 2, 1904.

During the years 1911, 1912 and 1913 he visited various clinics in Europe and in this country, studying under many of the leading physicians in his chosen field. Among these was Dr. Ludwig Kast at New York Post-Graduate School of Medicine, during 1911. He also studied at clinics in Berlin, Vienna and Halle, under Drs. Martin Haudek, G. Holzknacht, Siegmund Kreuzfuchs, and M. Sussman, during 1912. He began his special practice of gastroenterology in St. Louis during 1912, and his contributions to the medical science and the record of his valuable and extensive clinical practice bear full testimony to the unusual ability and capacity for labor which he possessed.

Dr. Mills was associated with Dr. H. W. Soper as a partner in the practice of gastroenterology from November 3, 1913, to the time of his death. While a great deal of his work was in connection with radiology, Dr. Mills always did a large amount of clinical medicine. He was assistant physician and roentgenologist at Barnes Hospital, and gastro-enterologist to out-patients at Washington University Dispensary.

Among the societies in which he held membership are: American Gastroenterological Association (President 1923-1924); St. Louis Society of Internal Medicine (President during 1923); American Medical Association; St. Louis Medical Society; St. Louis Naturalists' Club; St. Louis Anthropological Society; American Ornithologists' Union; Radiological Society of North America; American Roentgen Ray Society; Phi Delta Theta (Missouri Gamma Chapter); Phi Delta (Alpha Zeta Chap-



THE LATE R. WALTER MILLS, M.D.

ter). Soon after his death, a posthumous fellowship in the American College of Physicians, the first ever granted to a departed physician, was awarded to Dr. Mills.

The bibliography which follows indicates the boundless energy necessary to produce so much original material during the short time which he lived.

B. H. ORNDOFF, M.D.

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MEMORIAL EXERCISES IN ST. LOUIS TO DR. R. WALTER MILLS

Memorial services to Dr. Mills were held at a special joint meeting of the St. Louis Medical Society and the Washington University Medical School in the Auditorium of the latter, on Sunday, March 16th. The chairman, Dr. Roland Hill, President of the St. Louis Medical Society, read a letter from Mr. Robert S. Brookings deploring the great loss which the University had sustained in the death of Dr. Mills.

DR. HANAU W. LOEB, Dean of the St. Louis Medical School, said in part: On

the first of October, 1899, a young man presented himself for registration in the Marion-Sims College of Medicine, of which I was at that time Secretary. He was a quiet-looking young chap with deep-set eyes, unimpressive in his appearance and extremely diffident, or at least bashful. After some little conversation I learned that he was a Bachelor of Science from the University of Illinois, who desired to take advantage of our requirements which at that time permitted a university graduate to complete his medical work in three years. He was regularly admitted into the sophomore class on this basis and in the course of the next three years made up the deficiencies of his first year. This was my first introduction to Walter Mills, or, as he gave his name, Ralph Walter Mills.

Entirely bereft of any outward expression of the fire that was in his soul, the first impression one gained was merely that of a somewhat diffident, thoughtful student without dash or enthusiasm. In the three years during which he attended he justified the impression of thoughtfulness, modesty and earnestness, but he drove far beyond the evidence of spirit, thoroughness, and happiness in his work that his features suggested.

It was some time after he had been in school that I learned of his artistic ability and only by dint of earnest solicitation was I able to get him to show me the wonderful work which he had done in illustrating the various species of fish in the State of Illinois. My complimentary references to them fell on deaf ears and from his bored expression I learned that if I were to establish closer contacts with this young man it would be necessary to respect his modesty.

I learned casually afterwards that he was Varsity track champion for the 220-yard distance. Later in life I was to learn many other side lines in which his superiority had been established. So far as he was concerned himself, however, he carefully kept all of these high qualifications from public view, not as so frequently happens to spring them suddenly and enjoy the

distinction of spontaneity, but because his soul rebelled against any expression of pride whatsoever.

His work throughout his school life was true to type and he qualified as one of the three highest men in the class, but without exciting any particular notice and certainly without any envy on the part of his school-mates. He was just a sturdy student, earnest and devoted, loving his work for the work's sake and keeping in mind that the achievement of a medical education was the goal to which he should press forward with all the energy of his soul.

DR. EVARTS A. GRAHAM: To attain moderate excellence in one's work is for most men a sufficient success. But to ambitious men like Mills nothing is satisfactory that falls short of perfection. We whose pleasure it was to work with him daily know full well how close he came to the attainment of a degree of successful accomplishment which was little short of perfection in his chosen field of diagnosis of conditions of the gastro-intestinal tract. My own all too brief acquaintance with him began in the Fall of 1919. I can still vividly remember with what amazement I heard him say a few months later that a patient of mine whom he had been studying had an adenoma of the stomach. I regarded the X-ray diagnosis of such a condition as impossible and I can well remember my skepticism. But that was because I did not know Mills and his capabilities. To those of you who knew him and his work it will be no surprise to hear that a few days later at operation I found an adenoma. More than four years now since the removal of that adenoma the patient is entirely well. Could anything be a more startling confirmation of the super-excellence of this master?

An uninformed observer who watched Mills at the fluoroscope making examinations with lightning speed would be perhaps justified in thinking either that there was something of the magician about him or that his diagnosis must rest on a very in-

secure foundation. But after all, that was surely because he saw a master at work. There was no chicanery and no haphazard process in it. The keen observation which could in a moment detect an abnormal condition where other eyes, less keen, might see nothing had arrived at its perfection only through the tireless effort spent during many years in the school of hard work. There is no short cut to great attainment. In science, particularly, there is no "get-wise-quick" road to success. Sometimes, it is true, a great discovery comes with astonishing suddenness, but, in the words of Pasteur, it is because an idea has come to the mind prepared to receive it. Mills' life was a striking example of these platitudes. Despite the astonishing speed with which he seemed sometimes to arrive at a diagnosis his methods in reality were most laborious. The thousands of carefully kept routine records bear witness to the painstaking character of his work, records which, because of the great care with which they have been made, will yet reveal new important generalizations of truth even although the author of them has passed on from amongst us.

To those who were most intimately associated with him his thoughtfulness of others was always striking. I remember that on many an occasion he discussed with me his worry that perhaps his assistants in the X-ray department were compelled to work too hard, that perhaps he was driving them too much. There was never any thought in his mind, apparently, that he might be driving himself too hard. He did expect hard work from those with whom he was associated, but he made no greater demands from others than he made upon himself. Even in the sudden shock of the information that he had leukemia one of his chief concerns was whether or not his assistants in the department were adequately protected against the injurious action of the X-rays. With prophetic insight, but yet with unflinching courage, he expected that some day he would fall a victim himself to the

X-ray, but he had the earnest desire that none of his assistants should be so afflicted.

DR. R. D. CARMAN, Rochester, Minn.: In 1910, R. Walter Mills, then a young practitioner of medicine, returned to St. Louis after a few months' sojourn in Europe. I had known him as a student with a pleasing personality and a bright mind, alert for all the facts and theories of medicine. I had known him also as an artist of ability, and his drawings were appearing on the pages of medical books and journals.

While abroad, Dr. Mills had devoted his attention to internal medicine and especially to diseases of the digestive tract. About that time Rieder, Holzknacht, Faulhaber and others were investigating the radiology of the digestive tract, but their work was not yet taken seriously. Some of their papers had come to my notice and I was trying to apply their methods. When Walter came home I learned that he had given little attention to the X-ray side of the subject. I gave him some of the literature. He read it avidly. It offered a hope of objective diagnosis and his interest rose to white heat.

Walter came to work with me at the old University Hospital on Jefferson Avenue. Our knowledge was scant, our work was crude, the surgeons and clinicians were skeptical, but we were never cast down. Who could lose courage with Walter about?

Stimulated by his observations he determined to make another trip abroad. I urged him to visit Vienna, where the greatest advances had been made. This he did, spending several months with Holzknacht and Haudek.

From our examinations certain facts soon became apparent. For one thing the stomach depicted in the text-books was ideal, not real. The real stomach varied as to form, size, position and functional behavior according to body build. No single, standard, normal stomach existed; there were *many* normal stomachs. We empha-

sized this fact in our first joint paper and I shall never forget the many interesting hours I spent with him in its preparation. Walter continued the work on habitus after I left St. Louis and his skill in drawing fitted him especially to carry it on. Many other fine things he did, but that, I think, was his outstanding achievement, his greatest contribution to American roentgenology.

What followed you know. Elected to membership in many societies he soon ranked with their leaders. He made new and steadfast friends everywhere. His activities increased. The radiology of the small bowel and colon interested him deeply and he planned to study them intensively. When he became aware of his impending doom, Walter had no fear, but regretted only that he could not finish these investigations.

However complex may have been the causes of his death, there can be little doubt that his exposure to the X-ray was an important factor. As he served the cause of roentgenology in life, so even his death may serve to warn his co-workers of their danger.

It is scant justice to say that Walter Mills had a bright mind, for it was truly incandescent, crowded with a tumult of thoughts. Much of his thinking was intuitive and problems that most of us mull over and clumsily reason out were solved by him in a flash.

Deft with his pencil, he was no less an artist with words. All the finer shades of meaning were at his command. His sketchy verbal cartoons were more convincing than long and logical argument. He could not be narrow. He saw from many angles of view at once and he realized that the truth we all seek is many sided.

Though deeply occupied with the complex phases of a special science he was none the less a philosopher. For example, in an address on the relation of roentgenology to clinical medicine, he showed his depth of thought as well as beauty of expression.

Speaking of gastro-intestinal roentgenology he said: "It has no limitations. The limitations are our own. Its only weakness is in its strength, in that it displays a living pathology so bewildering that we are as yet unable to arrange much of the evidence to fit present conditions." Then, without attempting to forecast the future, for he denied the gift of prophecy, Dr. Mills considered the various methods of practicing roentgenology, whether as an isolated specialty, or of dividing it into sub-specialties, or making it a part of the clinical examination. The gain and loss from each of these methods he set forth clearly and fairly, but left his hearers to choose as they wished.

I would not laud him beyond his just deserts or paint him as a superman. With his saving sense of humor he would be the first to laugh at unearned praise. But, in sober truth, he was rounded out and balanced well.

On the last evening of his life I went to see him. "Are you in pain, Walter?" I asked. "No, Carm," he said, drowsily, "but I am so tired—so—tired." That night he rested forever.

It is not for us to pity his passing, but to exult over what he was and what he did, to be glad that he lived, worked faithfully at the plans on the trestle board of the Great Architect, loved his fellowmen, and has laid him down to an untroubled sleep.

Walter Mills—genius, good fellow and good friend—I salute you! Hail and farewell!

REV. DR. DAVID M. SKILLING, Dr. Mills' pastor, paid a warm tribute to his high personal qualities, and related incidents illustrating Dr. Mills' tender solicitude for his patients, his resourcefulness, courtesy and generosity, and his deep affection for all living things. Dr. Skilling closed by saying: "The work of Walter Mills was far greater than the world has appreciated. His reward is not in material success, but in the help he has given humanity and in the approval of eternity."

A SUMMARY REVIEW OF THE HOSPITAL CONFERENCE OF THE CLINICAL CON- GRESS OF AMERICAN COLLEGE OF SURGEONS¹

"The essentials are [in the standard hospital]: (1) There shall be an organized staff willing to assume the obligation of teaching internes by personal instruction and by monthly clinical conferences. (2) The hospital must have a pathological department, suitable laboratories, X-ray equipment and roentgenologist, library, and proper quarters for the internes. (3) Real records of cases must be systematically taken and properly filed under the care of a librarian. (4) The work of the internes must be regulated so that they will systematically take up history-taking, clinical laboratory work, X-ray, anesthesia, maternity cases, necropsies, responsibility for the diagnosis and care of patients, surgical dressings, operations, etc.

"*X-ray Department.* This is a very important diagnostic and therapeutic department nowadays in hospitals. It is, indeed, a rare thing to find a hospital without an X-ray service. The rapid development, however, needs more words of caution and warning lest the quality of service deteriorates. The principles of development and management are much the same as in the case of the clinical laboratory. The main speaker on this subject brought out all the facts concerning the efficient operation of this service in any hospital. Some of the more outstanding features which were referred to may be summarized as follows: The personnel of the X-ray department should consist of a radiologist who should be in charge. This should be a medical man, preferably one of clinical ability and experience. It is always advisable, if possible, to have a young physician in training as an understudy. There should be as many technicians as the work of the institution may require. The X-ray should be located adjacent to the operating room, so as to

¹These extracts are reprinted, by permission, from *Surgery, Gynecology and Obstetrics*, Jan., 1924, p. 137.

promote good teamwork between the surgeon and the radiologist. There should be sufficient floor space to provide for at least a waiting room and office, and view, operating, fluoroscopic, filing, and developing rooms. The equipment must be adequate for carrying on radiographic and fluoroscopic work, as well as doing superficial and deep therapy where deemed advisable. All interpretations must be done by a competent medical radiologist. A record of the work should be kept in the department and a duplicate copy sent up to the ward to be attached to the patient's file. Radiologists should be freely employed as consultants to the staff and should attend the staff meetings. It should be their privilege and duty to make any X-ray examination which, in their judgment, might throw light on the condition of the patient. The activities of the department, like the clinical laboratory, should be confined to the institution alone, unless it happens to be the only available X-ray in that community."

"RADIOLOGY" WINS IN COURT

Members of the Radiological Society of North America will be gratified to know that the litigation instituted against the Society, Dr. Russell D. Carman, president of the Society last year, and J. R. Bruce, business manager of the journal, by Dr. A. F. Tyler, to restrain the publication of RADIOLOGY has resulted in favor of the Society on every point at issue. The decision was handed down by Judge R. D. O'Brien of the Minnesota District Court, Monday, April 21st last.

The action was commenced early last fall, when a motion was made for a temporary injunction to stop the publication of RADIOLOGY. The motion for the temporary injunction was argued before Judge Sanborn of the Ramsey County, Minnesota, District Court and was denied. In denying the motion, Judge Sanborn, in his memorandum, made the statement: "To hold otherwise would defeat the purpose for which the Society is organized and destroy

its usefulness." Subsequently, the case came on for trial February 25, 1924, before Judge R. D. O'Brien at St. Paul, Minnesota, the trial lasting almost two weeks. The Court seemed especially liberal in admitting evidence which in any way had a bearing on the questions at issue. At the close of the trial Judge O'Brien announced that he would reserve his decision and on April 21st handed down his Findings and Conclusions of Law in which he found on every point in favor of the Society, Dr. Carman and Mr. Bruce. Briefly summarized, these are the Findings:

As CONCLUSIONS OF LAW, the Court finds:

I

That the JOURNAL OF RADIOLOGY is the property of the defendant society and never at any time was the property of said Radiological Publishing Company.

II

That "RADIOLOGY," as published in St. Paul, Minnesota, is the official publication of the said defendant society, and that "THE JOURNAL OF RADIOLOGY" as published by plaintiff Tyler and his brother at Omaha, Nebraska, is not the official publication of said defendant society.

III

That by reason of their acts and conduct as hereinbefore stated, the plaintiffs are estopped and barred from making any claims as against the defendants by reason of any of the matters alleged in their complaint.

IV

That neither of the plaintiffs is entitled to any relief whatsoever.

V

That the defendants are entitled to recover their costs and disbursements herein.

AND LET JUDGMENT BE ENTERED ACCORDINGLY.

Dated at St. Paul, Minnesota, this 21st day of April, A. D. 1924.

By the Court:
(Signed) RICHARD D. O'BRIEN,
District Court.

In the memorandum accompanying the Findings the Court completely absolved the officers, other members of the Society and Mr. Bruce from any fraud, conspiracy or

evidence of bad faith in any respect, as has been charged by Dr. Tyler in his complaint.

The trial at St. Paul was attended by Dr. Rollin H. Stevens, Dr. Russell D. Carman, Dr. M. J. Hubeny, Dr. A. W. Erskine, Dr. Edwin C. Ernst, Dr. E. W. Rowe, Dr. M. J. Sandborn, Dr. I. S. Trostler, Dr. Benjamin H. Orndoff, and J. R. Bruce. Most of these men spent almost two weeks away from their work in order to give testimony for the Society and assist in establishing its right to publish its own journal and manage its own affairs.

The facts leading up to the litigation are, briefly, as follows:

In December, 1920, a plan for financing the Society's journal was presented and adopted in executive sessions at Chicago. Under this plan the Society endorsed and authorized the formation of the Radiological Publishing Company, the company to be owned and controlled entirely by members of the Society, the company to take charge of the publication of the JOURNAL OF RADIOLOGY. The organization of this company was authorized with the understanding that it should be incorporated in the State of Iowa with a capital stock of \$10,000.00 and that a Mr. Plumb of Iowa City, Iowa, should be engaged as business manager. Dr. A. F. Tyler, having the confidence, apparently, of every one and being the principal sponsor for the plan adopted, was elected president of the Publishing Company and instructed to proceed with the incorporation of the company as hereinbefore mentioned and to enter into a contract with Mr. Plumb to act as business manager. Contrary to these instruction, Dr. Tyler incorporated the Publishing Company in the State of Nebraska with a capital stock of \$20,000.00 instead of \$10,000.00. A short time after incorporation, Dr. Tyler entered into a contract with his brother, H. S. Tyler, to serve as business manager in the place of Mr. Plumb.

The Publishing Company was conducted at a heavy loss from its inception and Dr.

Tyler appealed to the Society for additional funds with which to carry on the work, stating at one time that \$10,000.00 additional was needed to make it possible for the Publishing Company to publish the JOURNAL OF RADIOLOGY.

During 1922, apparently in order to obtain control of the Publishing Company, Dr. A. F. Tyler issued to himself additional shares out of the treasury stock sufficient to give him more than fifty per cent of the stock outstanding, signed the certificates of stock without the knowledge or consent of the other officers or the Board of Directors, in whom was vested the right and power to issue stock. Dr. Tyler signed these certificates both as president and secretary.

In addition to the financial difficulties of the Publishing Company, the JOURNAL OF RADIOLOGY had been conducted in a manner unsatisfactory to the Society and a change in the management, which seemed in many ways extravagant and inefficient, was thought necessary.

The Board of Directors sought to make a change in the business management of the journal and to remove it from Omaha to another point where it could be published for a much smaller sum than was being paid for that part of the work in Omaha. Dr. A. F. Tyler, claiming to be the majority stockholder, refused to permit such a change to be made, his contention being that the Society had no right to interfere in any way with the publication of the JOURNAL OF RADIOLOGY by the Radiological Publishing Company. Claiming to be the majority stockholder, Dr. Tyler maintained that the authorization by the Society of the organization of the Radiological Publishing Company for the purpose of publishing the JOURNAL OF RADIOLOGY constituted an executed contract; that the journal no longer belonged to the Society, that it was the sole property of the Radiological Publishing Company, the stock of which he controlled; that the Radiological Publishing Company had a *perpetual and exclusive right* to publish the official journal of the Radiological Society of North America for

all time to come. Naturally, the officers of the Society could not consent to a surrender of its ownership of the journal and its right to control it.

Confident that the journal could not be continued under the conditions then existing and certainly not in a manner satisfactory to or fairly representing the ideals of the Society, it was decided that the Society should take over the publication of its own journal, effective with the January, 1923, number. Later on, however, it was found impractical to begin publication with the January number and as the time for the mid-annual meeting in San Francisco was not far distant, which would afford an opportunity of placing the whole matter before the members, it was thought best to postpone the publication of the journal until after the mid-annual meeting.

Every effort was made, however, to protect the stockholders of the Publishing Company and with a desire to safeguard the stockholders against any loss which might be caused by taking the JOURNAL OF RADIOLOGY away from the Publishing Company and, if possible, to avoid litigation, an offer was made in writing to Dr. Tyler by the officers of the Society to purchase all the outstanding stock of the Publishing Company at par and to assume all the indebtedness of the company. Dr. Tyler refused to accept this offer. The articles of incorporation of the Radiological Publishing Company provide that the highest amount of indebtedness to which the Board should at any time subject itself should not exceed two-thirds of the paid-up capital. In violation of this charter provision it became apparent in the fall of 1922 that the Publishing Company had contracted debts and obligations in excess of the two-thirds paid-up capital stock. On account of the financial condition of the Publishing Company a meeting of the Board of Directors was held at Omaha, December 29, 1922, in which the question of the future publication of the journal came up. It being apparent that the journal was being published at a heavy financial loss to the company, a reso-

lution was unanimously passed by the Board of Directors cancelling, rescinding, and annulling any and all contracts and arrangements had with the Publishing Company for the publication of the Journal of Radiology and to turn the journal back to the Society. Judge O'Brien in his decision held that this meeting of the Board of Directors was entirely proper and correct and that the Board of Directors acted in entire good faith as directors of the Publishing Company.

At the executive sessions held during the mid-annual meeting at San Francisco in June, 1923, the Executive Committee was authorized to enter into a contract with J. R. Bruce of St. Paul, Minnesota, to publish the Society's official journal under its sole ownership and direction. As Dr. A. F. Tyler and his brother, H. S. Tyler, were continuing to issue the "JOURNAL OF RADIOLOGY" at Omaha as the official publication of the Society, it was thought that confusion might be minimized by changing the name of the Society's journal to RADIOLOGY. The first issue of RADIOLOGY was published in St. Paul, September, 1923, and it has been published regularly each month since that time.

This being the situation, Dr. A. F. Tyler, for himself and as a stockholder in the Radiological Publishing Company, brought suit against the Society, Dr. Carman and Mr. Bruce, in the District Court of Ramsey County, Minnesota, as hereinbefore referred to, in which he charged that the defendants had been guilty of conspiracy as evidenced by the manner in which they took the publication out of the hands of the Publishing Company.

The decision of the Court, after hearing all the evidence, clears the Society, its officers and agents, of any misconduct or wrongdoing, and clearly establishes its right to manage and publish its own journal without outside interference.

From the date of its inception to the present time, RADIOLOGY has been successful editorially and financially. It has been the endeavor of the editors to maintain a

high editorial standard in every way worthy of the attention and respect of the members of the Society and other roentgenologists. Plans for the future provide for a larger volume of reading matter, although each monthly issue of the journal now carries almost one hundred pages of text. From a financial standpoint the eight numbers of RADIOLOGY issued to date show a very nice surplus for the Society.

PROGRAM OF MID-ANNUAL MEETING
OF RADIOLOGICAL SOCIETY OF
NORTH AMERICA, CHICAGO,
JUNE 6-7, 1924

- A. Mutscheller, Ph.D. (by invitation), New York—"Average Wave Length of X-rays."
- Dr. Byron C. Darling, New York—"The Sacro-iliac Joint: Its Diagnosis as Determined by the X-ray."
- Dr. Geo. F. Thomas, Cleveland, O.—"Injuries About the Wrist."
1. The relative frequency and importance of the more common injuries about the wrist, based upon analysis of cases from the author's own records.
 2. Anomalies and other sources of misinterpretation.
 3. The dependence of functional result upon anatomical relationship.
 4. The function of the roentgenologist in diagnosis and treatment.
- Dr. Bundy Allen, Iowa City, Ia.—"Pathological Fractures."
- Dr. Howard P. Doub and Dr. C. W. Peabody, Detroit, Mich.—"Generalized Osseous Dystrophies with Reported Cases."
- Dr. Henry W. Meyerding, Rochester, Minn.—"Radiographical Types of Bone Sarcoma."
- Dr. John T. Murphy, Toledo, O.—"Adamantinoma."
- Dr. Robt. Glenn Allison, Minneapolis, Minn.—"Bone Findings in Chloroma."
- Dr. W. Warner Watkins, Phoenix, Ariz.—"The Ethics of the Commercial X-ray Laboratory."

Dr. M. J. Sittenfield, New York—"Present Studies in Experimental Cancer."

Dr. Harry H. Bowing, Rochester, Minn.—"Significant Cellular Changes Observed in Irradiated Tissue, with Special Reference to Rectal Carcinoma."

Prof. C. M. Child (by invitation), University of Chicago—"Quantitative Factors in the Susceptibility of Living Cells to External Agents." (Lantern slides.)

Maud Slye, Ph.D., University of Chicago—(To be announced).

Dr. Geo. E. Pfahler, Philadelphia, Pa.—"A Case of Malignant Degeneration in Radio-dermatitis Successfully Treated by Electro-coagulation and Skin-grafting."

Patient operated upon in 1908. Enlargement of metastatic glands in axilla and supra-clavicular region two months later, followed by heavy X-ray treatment.

Malignant degeneration of the sclerotic areas in 1917, nine years after the surgical operation.

Destruction of the malignant disease by electro-coagulation.

Patient still well in 1924, sixteen years after operation.

Dr. R. D. Carman and Dr. Albert Miller, Rochester, Minn.—"The Occupational Hazard of the Radiologist, with Especial Reference to the Blood Changes."

Dr. C. A. Simpson, Washington, D. C.—"X-ray Treatment of Hyperthyroidism."

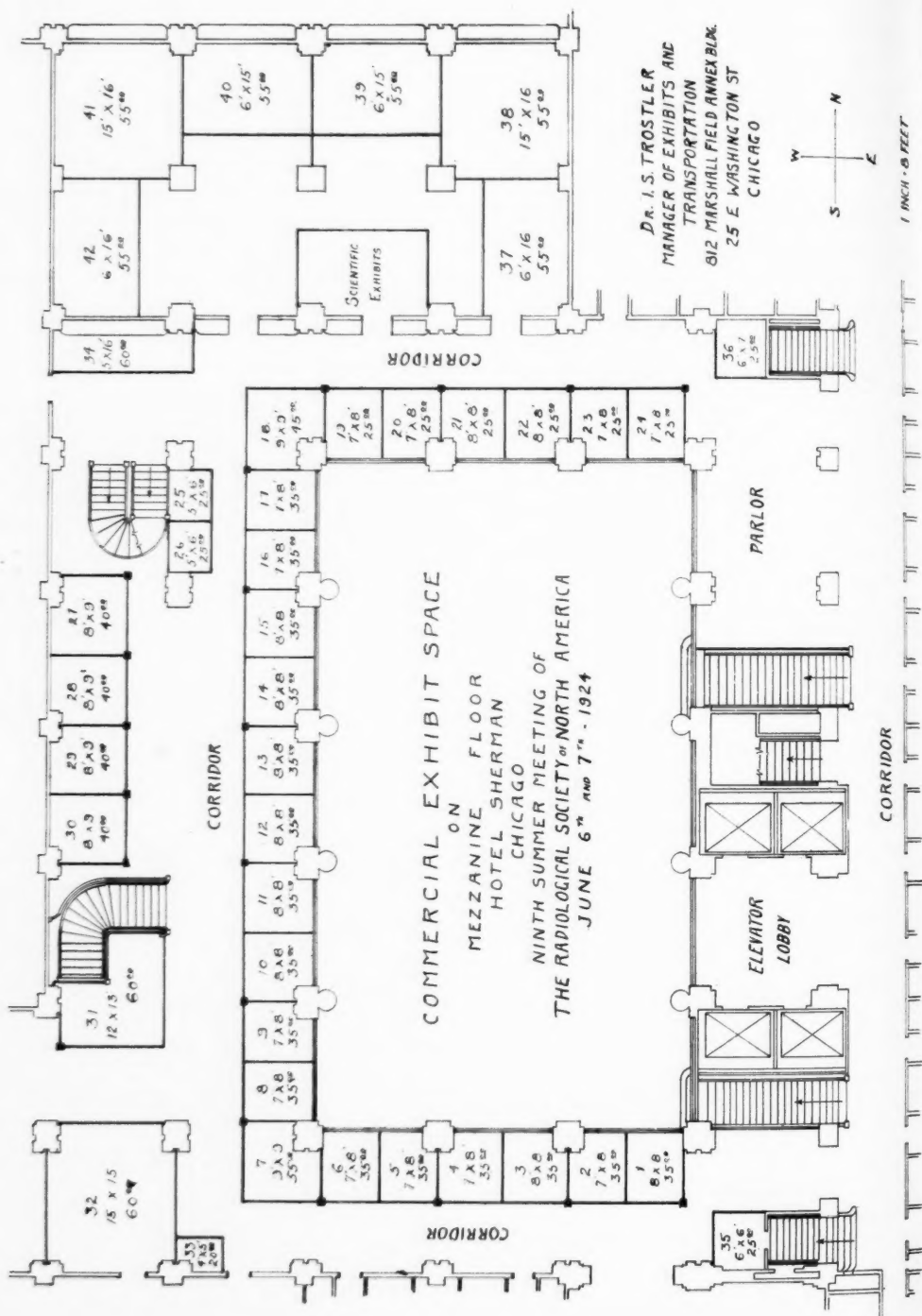
Dr. C. H. Nims, Hot Springs, Ark.—"Deep Therapy Simplified."

Dr. H. J. Ullmann, Santa Barbara, Calif.—(To be announced.)

Drs. Groover, Christie and Merritt, Washington, D. C.—"Pulmonary Tuberculosis as a Cause of Pain in the Shoulder."

Dr. I. S. Trostler and Dr. Robert H. Hayes, Chicago—"A Pathognomonic Radiographic Finding in Early Pulmonary Tuberculosis. Preliminary Report."

Dr. John D. MacRae, Asheville, N. C.—(To be announced.)



Dr. L. R. Sante, St. Louis, Mo.—“Miliary Tuberculosis—Radiographic Evidence of Chronic and of a Healed Form.”

The report is based on the observation of twelve cases of miliary tuberculosis, age of patients, mode of onset, course and duration of disease. Evidence of a chronic form. Is the disease invariably fatal? Evidence suggestive of a healed type of miliary tuberculosis.

Discussion to be opened by Dr. Edward S. Blaine, Chicago.

Dr. Herbert M. Rich (by invitation), Detroit, Mich.—“Classification in Lung Abscess with Regard to Treatment.”

Dr. Henry Schmitz, Chicago—“The Treatment of Surgical Tuberculosis by Quartz Light and X-rays.”

Dr. Evarts A. Graham and Dr. W. C. Cole (by invitation), St. Louis Mo.—“The Roentgenological Visualization of the Gall Bladder by the Use of Intravenous Injections of Calcium Tetrabromphenolphthalein.” (Lantern slides.)

Dr. Amédée Granger, New Orleans, La.—“New Device and Technic for Making Radiographs of the Mastoids in the Law and Arcelin Positions.”

Dr. K. S. Davis (by invitation), Rochester, Minn.—“Intrathoracic Changes as a Result of Roentgen Therapy: A Clinical and Experimental Study.”

Prof. Arthur H. Compton, University of Chicago—“The Mechanism of Ionization by X-rays.”

Dr. Leon J. Menville, New Orleans, La.—“Experimental Work Showing that the Roentgen Rays and Radium Rays do not Kill, and Apparently do not Affect the Viability of Tertian Malaria Parasites (*Plasmodium Vivax*) in Vitro.”

Dr. I. Seth Hirsch, New York—“Cancer of the Lung: A Clinical Roentgen Study.”

Dr. L. T. LeWald, New York—“Right-sided Diverticulitis.”

Dr. C. C. Grandy, Fort Wayne, Ind.—“Clinical Roentgenology.”

Dr. Lewis Gregory Cole, New York—“Results of Medical Cures of Gastric

Ulcers.” (Moving films illustrating motor phenomena of stomach sphincter and cap.)

Dr. W. O. Upson, Battle Creek, Mich.—“Benign Growths of the Stomach.”

Dr. Wm. L. Clark, Philadelphia, Pa.—“Preliminary Report on a Modified Fractional X-radiation Technic.”

Dr. F. P. Boswell, Montgomery, Ala.—“The X-ray Treatment of Acne.”

ESSAYISTS FOR THE A. M. A. MEETING

June 12 and 13, Municipal Pier, Chicago

The following papers comprise the program of the two half-days to be devoted to Radiology, under the Section of Miscellaneous Topics, during the Chicago Session of the American Medical Association. Whatever furthers the advancement of the science of Radiology, furthers the interests of each individual radiologist. Be sure, in registering, to write “Radiology” after your name.

“The Reaction of Different Types of Abdominal Tumors to Radiation.” A. U. Desjardins, Rochester, Minnesota.

Discussion to be opened by George E. Pfahler, Philadelphia.

“X-ray Studies in Hydrocephalus.” P. M. Hickey, Ann Arbor, Michigan.

Discussion to be opened by George L. Davenport, Chicago.

“Studies on the Effect of X-rays on Glandular Activity. The Effect on Gastric Secretion of Exposure of the Abdominal and Thoracic Areas to X-rays. A Note on Roentgen Cachexia.” A. C. Ivy, J. E. McCarthy, and B. H. Orndoff, Chicago.

Discussion to be opened by Charles L. Martin, Dallas, Texas.

“Comments on the Use of Radium for Intraoral Cancer.” Albert Soiland, Los Angeles.

Discussion to be opened by Frank E. Simpson, Chicago.

"A Radiographic Study of the Infant's Chest as Seen at Birth." W. Walter Wasson, Denver.

Discussion to be opened by Charles C. Grandy, Ft. Wayne, Indiana.

"Radiographic Localization of Lung Abscess with the Hirtz Compass: A Preliminary Report." L. R. Sante and Edwin P. Lehman, St. Louis.

Discussion to be opened by Edward S. Blaine, Chicago, and Evarts A. Graham, St. Louis.

"End-results Observed in Carcinomata of the Uterine Cervix with Radium and X-ray Therapy." Henry Schmitz, Chicago.

Discussion to be opened by John F. McCullough, Pittsburgh.

"The Importance of Careful Roentgen-ray Investigations of Apical Chest Tumors." Henry K. Pancoast, Philadelphia.

Discussion to be opened by William A. Evans, Detroit.

"The Treatment of Hyperthyroidism by the Roentgen Ray: Results in 125 Cases." Thomas A. Groover, A. C. Christie, and E. A. Merritt, Washington, D. C.

Discussion to be opened by Robert G. Allison, Minneapolis.

"Some Observations on the Use of the X-rays in the Diagnosis of the Pericardium." George W. Holmes, Boston.

Discussion to be opened by Paul Dudley White, Boston.

"Results of Medical Treatment of Gastric Ulcer as Observed by Serial Roentgenography." Lewis Gregory Cole, New York.

Discussion to be opened by Bertram W. Sippy, Chicago.

"A Study of Thirty-one Cases of Complete Transposition of the Viscera, with Remarks on Etiology" (lantern demonstration). Leon T. LeWald, New York.

Discussion to be opened by James T. Case, Battle Creek, Michigan.

Classification of epitheliomata.—The more an epithelioma tends to differentiate, the lower is its degree of malignancy. Conversely, the more embryonal or undifferentiated the cells, the higher the degree of malignancy. On this basis, Broders, in 1919, classified epithelioma of the lip into four grades, and has since extended this grading to cover squamous epitheliomata in general.

If an epithelioma shows about three-quarters of its structure differentiated epithelium and one-quarter undifferentiated and so-called "one-eyed" cells, it is called Grade I. If the percentages of differentiated and undifferentiated epithelium are about equal, with an occasional mitotic figure and "one-eyed" cell, it is Grade II. If the undifferentiated epithelium forms about three-fourths and the differentiated about one-fourth, with numerous mitotic figures, it is Grade III. When there is no tendency for the cells to differentiate, it is Grade IV.

The difference in sensitiveness of cancer cells to radiation depends, first, on their age, the momentary period in which they happen to be; second, the age of the host; third, the histologic species in each case. It is a universally accepted law of radiation that the more embryonal, undeveloped, or undifferentiated the malignant cells, the more sensitive they are to radiation.

The histologic changes produced by radiation are similar for all four grades, the difference be-

ing in the degree of sensibility. Grade I is the most resistant, while Grade IV is the most sensitive. After radiation, within a few days there is observed a general hyperemia of the tissues, with a beginning exudation of lymphocytes and polymorphonuclear neutrophiles; in the second stage (second to third week), all the surrounding tissues are more or less swollen; the nuclei of the tumor cells are swollen and homogeneous and the entire section begins to appear structureless; the cell bodies are enlarged and the cells seem loosened and torn away; vacuoles are seen in the cytoplasm and fusion giant cells are present. Following this period, there occur liquefaction necrosis, reduction in number of tumor cells and a beginning invasion of lymphocytes and fibroblasts; in the third stage the cells are practically destroyed or so encapsulated by fibrous tissue that they are inactive; fragments of nuclei and giant cells remain, the former being actively removed by the phagocytic leukocytes. The fourth stage is one of fibrosis.

This report is based on over one hundred epitheliomata in which histologic studies were made before and after radiation treatment.

W. W. WATKINS, M.D.

The Grading of Epitheliomata and Their Radiation Sensibility. Rex Duncan and E. D. Ward. *New York Medical Journal and Medical Record*, Dec. 5, 1923, p. 681.

ABSTRACTS OF CURRENT LITERATURE

Syphilis.—Eustermann, in 1918, reported from the Mayo Clinic about two hundred cases of gastric syphilis clinically diagnosed. Since then about fifty cases have been reported.

GASTRIC SYPHILIS

A discrepancy is apparent between the relative rarity of the few cases seen by the pathologist and the more common incidence seen by the clinician. Necessary proofs of diagnosis are: (1) the existence of syphilis, not only by Wassermann test, but by other evidence, or a positive history of primary, secondary or tertiary lesions; (2) demonstration of the gastric lesion by the usual clinical methods, including the X-ray; (3) not only symptomatic, but objective therapeutic improvement, and (4) the clinical course of the disease.

According to Fowler, a positive Wassermann reaction in the presence of a definite gastric lesion does not prove that the lesion is syphilitic, and syphilis may exist in the absence of a positive reaction.

Symptomatic improvement, especially subjective, occurs in the various visceral manifestations of syphilis following efficient active treatment. However, if the essential pathologic process is considered, it is not difficult to see that, as a part of the healing, deformities and mechanical difficulties may develop or increase, for, as the gummatous process heals, a contracting scar is formed. This cannot be differentiated from that of any progressive lesion of the proliferative type, such as carcinoma.

The steady and continuous progress to a fatal termination which characterizes cancer is not present. Cachexia is less common and less marked than in cancer. It is frequently hard to distinguish the gross lesion from cancer; changes in the gland may be simply inflammatory in either condition when the gastric mucous membrane is ulcerated. A case is cited in which external and systemic evidence of syphilis, positive Wassermann reaction, and an extensive gastric lesion were present. Necropsy revealed tertiary lesions in the liver and extensive gastric cancer. The presence or absence of occult blood in the stools or gastric content is of considerable value in differentiating gastric syphilis from cancer, provided stools are examined over a considerable period. Cancer oozes continuously; gummatous ulcer rarely oozes continuously, and especially not after specific treatment.

INTESTINAL SYPHILIS

Literature concerning intestinal syphilis is meager. Fraenkel found three cases in 19,000

necropsies. Oberndorfer, in 1900, collected only twenty-four authentic cases, in sixteen of which the lesions were in the small bowel alone and two in both the large and small bowel. Two forms of intestinal syphilis are observed: (1) early acute catarrhal enteritis occurring as part of the secondary exanthema, and (2) late involvement or tertiary lesions with symptoms of ulcerative enterocolitis.

Except for the rather typical, long, narrow, tubular, smooth strictures seen when the disease is confined to the rectum and sigmoid, the roentgenogram of lesions elsewhere in the colon can scarcely be distinctive.

The great discrepancy between the numerous reported cases of clinical syphilis of the stomach and intestines and the few diagnosed from the histopathologic findings is explicable by the various interpretations of the essential findings of the pathologic conditions of the digestive organs by various authors.

The rarity of syphilis of the stomach and particularly of the intestines is opposed to any known typical clinical symptoms.

The highly subjective element in the evaluation of the results of specific treatment renders the results of treatment only of doubtful importance in the differential diagnosis. Hence all the reported cases based on clinical symptoms, Wassermann reactions and results of treatment, are not all convincing. Even the microscopic diagnosis is difficult. A detailed report with post-mortem findings is given of a patient observed for three years, who developed intestinal syphilis from which he died.

A series of peculiarities of the histopathology which aids in differentiating this condition with exceptional exactness is described: (1) small cellular infiltration; (2) uniformity of the nuclei shows that the cells are not leukocytes; (3) these cells have a typical relation to the tissues, especially the vessels (they do not involve the vessel along its whole extent but only in parts, which seems to be a characteristic peculiarity of the syphilitic poison), and (4) uncharacteristic granulation tissue which leads to infiltration and afterward to disintegration of the digestive tube.

The necropsy findings in the case reported were: chronic mesenteritis with aneurysm of ascending aorta, leather-bottle stomach, and multiple ulcers of the terminal ileum, colon and sigmoid.

The entire stomach was altered, producing a leather-bottle form, with walls about twice the normal thickness; the mucosa had lost its vel-

vety appearance, and was firm and indurated. No ulcerative lesions of the mucosa were noted.

The small bowel was negative up to 120 cm. proximal to the ileo-cecal valve, where six ulcers appeared, with many more in the large intestine. The largest was 5 by 1 cm., elliptical, the long diameter perpendicular to the long axis of the bowel, the ulcer floor below the level of the mucosa, and the margins being distinctly indurated. The stages of development of the ulcer were: (1) small and superficial defect of the mucosa; (2) bottom of mucosal defect sloughed and complete ulcer formed; (3) ulcerated bottom cleaned; (4) repair of ulcerated mucosa begun, and (5) circular scar in place of former defect.

J. D. CAMP, M.D.

Gastric and Intestinal Syphilis: Report of a Case, Clinical Course and Morbid Pathology. W. E. Gatewood and A. Kolodny. *Am. Jour. Syph.*, VII, 1923, p. 648.

Goiters.—The author classifies goiters as simple, cystic, colloidal, adenomatous, exophthalmic, and malignant. Of these, the adenomata with hyperthyroid symptoms, the exophthalmic and the malignant are suitable for X-ray therapy. He reviews the reports of a number of X-ray workers, including Halstead, Pfahler and Zulick, Grier, Lichty, Holmes and Merrill, Soiland, Allison, Beard and McKinley, Seymour, and Story. He quotes Means and Aub as reporting the largest series of cases accompanied by careful metabolic studies, as compared with parallel cases treated surgically. The conclusions of these latter writers were: (1) Results were equally good with X-rays or surgery after two or three years; (2) after surgery the metabolism shows a rapid preliminary fall, followed by a secondary rise, while with X-ray there is a gradual progressive fall; (3) in securing the same results with surgery or X-rays a lesser rest factor is necessary with X-ray treatment—with X-rays there is no mortality; (4) patients treated surgically do better and the risk of operation is less if they have previously had their thyroid and thymus glands irradiated; (5) risk of operation is greater and need for pre-operative X-ray treatment is greater in cases with a very high metabolism and moderate tachycardia, than in those with extreme tachycardia and moderate metabolism elevation; (6) the safest program for the treatment of exophthalmic goiter as a whole is the roentgen irradiation of the thyroid and thymus glands in all cases, with surgery reserved for those who do not do well; (7) surgery is contra-indicated in patients whose metabolism is rising in spite of complete rest in bed and also in patients with moderate tachycardia and great

metabolism increase, except when they have previously had thyroid and thymus glands radiated by X-ray.

The opposing views of C. H. Mayo and Crile are quoted and discussed.

The author's technic is to treat the thyroid and thymus areas on each side separately, using 4 mm. aluminum, 9-inch gap at distance of 9 inches, for 6 minutes to each area. If tonsils show hypertrophy they are included in the treatment, extending the distance to 12 inches and time to 9½ minutes. Second treatment is given three weeks later, and third four weeks after the second, the interval between treatments being increased one week each time. He has rarely noticed any change at time of second treatment; this is usually noticed at the third visit (seven weeks after the first treatment). Plummer's findings that the effect of thyroxin lasts thirty to forty days explains this apparent delay in effect. The eye symptoms due to goiter are the last to show improvement.

W. W. WATKINS, M.D.

X-ray Therapy of the Thyroid Gland. John G. Williams. *New York Medical Journal and Medical Record*, Oct. 17, 1923, p. 480.

Treatment of benign and malignant conditions.—The physiologic action of radiant energy is exerted upon the cell nucleus, delaying or wholly preventing cell division, and since the cancer cell is short-lived, it soon becomes harmless if division is prevented.

The technic required is to deliver the lethal dose for cancer cells into every part which may be the site of malignant disease, and do this without permanent damage to normal tissues.

The tissue and blood changes from heavy irradiation are great and proper preparation of the patient is essential; also, the amount of radiation delivered within a given time should be within the toleration limits of the patient.

As a general treatment, pre-operative treatment of malignancies is preferable to post-operative radiation. The success with which radiation attack is attended will vary according to the part of the body involved, and cancer in several anatomical localities is discussed.

In the uterus, carcinoma of the fundus can usually be successfully handled by surgery alone, but in carcinoma of the cervix surgery has been far from satisfactory; in the latter, the author's position at present is as follows: consultation between surgeon and radiologist to map out the plan of attack; in operable cases, radium should be applied to the primary lesion, followed by radical operation after ten days, and as soon as possible, short wave X-radiation to entire pelvis. Borderline cases should rely on radiation,

which should be given with most scrupulous thoroughness; advanced inoperable cases should have palliative treatment, with whatever hope there may be in arresting the disease.

In the breast, the technical difficulties of radiation are much greater than in the pelvis. All operable breast cancer cases are primarily surgical and radiation should be regarded as a reinforcement agent. The surgeon should give careful consideration to the question of pre-operative and post-operative radiation.

In skin cancer the basal type will usually give good results regardless of the method of destruction employed.

The author has seen no encouraging results in carcinoma of the tongue, epithelioma of the mouth or rectum.

It is in non-malignant disease that the radiologist reaps his greatest reward in satisfactory results, and there, too, he meets the sharpest objections of the surgeon who, likewise, gets his best results in this field.

In myoma of the uterus, except for the contra-indication of producing menopause in women under thirty-five, there are no contra-indications for radiation of myoma or its essential symptom, menorrhagia, the procedure being successful in practically all cases, and there being no mortality.

In exophthalmic goiter and hyperthyroidism, the purpose of radiation is to produce a mildly depressant effect upon glandular activity, and with proper technic it seems possible to accomplish this in a large percentage of cases. Carefully compiled results would compare favorably with those of surgery.

W. W. WATKINS, M.D.

Concerning Modern Radiation Therapy and Its Indications in the Treatment of Certain Benign and Malignant Conditions. Frank S. Bissell. *Minn. Med.*, Nov., 1923, p. 646.

Tuberculous lobar pneumonia.—The author discusses thirteen cases of this disease, the roentgen picture of which, in the acute stage, is often mistaken for that of pneumococcus lobar pneumonia. Clinically the onset is sudden, with chills or chilly sensations, high temperature, rapid respiration and pain in the chest. The leukocyte count may be high but never so high as that encountered in true lobar pneumonia. Defervescence is by lysis and it is not until the time for crisis has passed that suspicion is aroused. Days and weeks may pass without clinical evidence of resolution and fever continues. The examination of the sputum discloses large numbers of tubercle bacilli and in this manner the true nature of the condition is determined.

Of the thirteen cases reported, ten occurred in the right upper lobe, one in the left upper lobe,

one in the right upper and middle lobes, and one involved the entire right side. The disease seems prone to develop in individuals previously afflicted with tuberculous disease, and occurs in locations previously the site of mild tuberculous involvement.

Roentgenographically considered, the consolidation, when at its height, resembles in all aspects that of lobar pneumonia. Dense consolidation is seen, confined to one or more lobes, often with a relatively small amount of involvement elsewhere in the chest. The exact method of invasion cannot be indicated with certainty. Resolution of the consolidation requires several months. Gradually the shadow becomes mottled and blotchy in appearance, and there is evidence of cavity formation. The cavities are usually multiple, well defined, and occasionally become fibrosed.

J. D. CAMP, M.D.

Tuberculous Lobar Pneumonia (Pneumonic Caseous Tuberculosis). L. R. Sante. *Am. Jour. Roentgenol.*, XI, Jan., 1924, p. 55.

Irradiation of scleroderma.—In scleroderma the authors employ mild irradiations of 3 to 4 units H, using a No. 8 Benoist filter through 1 to 2 mm. of aluminum; two weeks are allowed to elapse between treatments.

Radiotherapy applied locally can, in the majority of cases, cause an arrest of development of scleroderma plaques, an attenuation of the morphea and even in certain cases complete recovery. Despite these very appreciable results the older treatments must not be lost sight of as they give equally good results; they have their indications and it might be well to combine them with radiotherapy.

In the case of slightly extensive or not very numerous morphea the authors have frequently employed negative electrolysis, the needle being connected with the negative pole. As with radiotherapy, the first effect obtained is the arrest of the extensive progress of the scleroderma, then slow regression of the patch.—*Electro-radiotherapy in Scleroderma (L'électro-radiothérapie des sclérodermies).* J. Belot and L. Nahan. *Jour. de Radiol. et d'Electrothérapie*, VI, 1922, p. 515.

Tuberculous glands.—The basis for the claim that radiotherapy, especially X-ray, is particularly adapted to the treatment of tuberculous glands is that glandular and lymphoid tissue in general is more amenable to the X-ray than is other tissue.

In treating tuberculous glands, we must not forget that we are probably treating a patient

with diffuse tuberculosis, and must not overlook the general reaction.

Tuberculous glands may be of three kinds: (1) non-suppurating hyperplastic glands, as found particularly in children, these being very amenable to X-ray treatment; (2) closed suppurating or partly caseous glands, which should be irradiated before any operation, to lessen the tendency of spreading infection; (3) glands which have discharged and where sinus only is left, X-ray will tend to destroy the exuberant granulation tissue and favor healing.

The advantages of radiotherapy over surgery are: (1) there is a local as well as general reaction in all three types, justifying its use in place of or, at least, just prior to surgery; (2) the individual is not left in a state of hypersusceptibility by radiotherapy; (3) no anesthetic is necessary; (4) little or no scar is left; (5) no pain; (6) less likelihood of extension and recurrence; (7) patient can continue at work. The chief disadvantage is the time element, as several months are required.

A small dose of short rays, properly filtered, are preferable to larger doses; general hygiene must not be neglected, as tuberculous adenitis is a local manifestation of a lowered resistance to a diffuse infection. Pus foci draining into the cervical glands from teeth and tonsils must be gotten rid of.

W. W. WATKINS, M.D.

Radiotherapy of Tuberculous Lymph Nodes. Philip H. Pierson. *Calif. St. Jour. of Med.*, XXI, Sept., 1923, p. 378.

Cancer of the lung.—Attention is called to the great advances which have been made in lung surgery, especially of infections. Very few cancers of the lung have been operated upon, however. The author says: "I have seen weeks or months wasted in pure clinical examination, leaving so harmless and accurate an adjunct as roentgenography to be used at last merely as a means of confirmation instead of in the beginning, to show at least the location and size of the lesion."

Cancer of the lung may begin in some part of the bronchial system, usually at a secondary fork, or it may start in the parenchyma of the lung. In the former case there usually are symptoms early in the disease, in the latter instance the growth may attain great size without symptoms. Primary tumors of the parenchyma may occupy a surprisingly large portion of the lung with no indication that function has been impaired.

The early diagnosis must depend on the X-ray and bronchoscope. The clearly marked circular shadows of parenchymatous infiltration by cancer will appear very early in the development of

the disease, far earlier than the ear can detect changes by percussion or auscultation. It is the writer's belief that in the near future lobectomy for wide excision of such conditions will be commonly practiced. Bronchoscopy should be the method of choice in the diagnosis of lesions beginning within the bronchi.

L. R. SANTE, M.D.

Malignant Tumor of the Lung: Necessity for Early Operation. Howard Lilienthal. *Archiv. of Surg.*, Vol. VIII, No. 1, Part 2, Jan., 1924, p. 308.

Hemangioma, with calcification.—Hemangioma is not usually characterized by calcification and when this does occur the X-ray appearance is that of round or oblong bodies with concentric rings within them. They are distributed irregularly and usually in the extremities, most often in the forearm and hand.

Case of girl, 15 years old, pain in forearm being first noticed when five years old; attack lasted two days and recurred in two months, intervals becoming shorter and attacks more painful. Swelling appeared two years ago over middle of the radius on both surfaces of forearm; there was no redness or other discoloration. X-ray report designated the condition as hemangioma with calcification, which was confirmed by operation. Eleven calcified bodies were removed, the largest being about .6 cm. in diameter.

W. W. WATKINS, M.D.

Hemangioma, with Calcification: Pre-operative and Post-operative X-ray Findings. H. J. Ravold. *Jour. Mo. St. Med. Assn.*, XX, Sept., 1923, p. 318.

Diagnosis of ileo-colic stasis.—In the final analysis the X-ray assumes the most important rôle in the diagnosis of a true stasis. The retention of the barium meal in the ileo-colon after twelve hours represents a definite indication of a retarded fecal current in this region. Serial examinations, made at further periods of 18 hours, 24 hours and 48 hours, will afford added evidence in respect to the extent and the degree of the stasis present.

W. W. WATKINS, M.D.

Ileo-colic Stasis: Its Clinical Consequences and Treatment. Sidney K. Simon. *Sou. Med. Jour.*, XVI, Oct., 1923, p. 737.

Keloids and their treatment.—A keloid is essentially a hypertrophic scar, usually raised, shiny, hard, pink to waxy in color, which has developed following some trauma. The cause of keloids is not known. The chief requisite in treating keloids is to produce the best possible

cosmetic result. While it is impossible to replace a keloid with normal skin by using radium, it is possible to give the patient a thin, supple scar, level with the rest of the skin and painless.

For very extensive lesions, especially those involving the chest or limbs, X-rays may be used. Treatment should be started as soon after the keloid begins to form as possible, as a pink, supple lesion gives a much better prognosis than a contracted, waxy, hard one. The production of telangiectasis is less likely to occur in keloids than in treatment of many other skin lesions.

The author uses all available rays of radium, aiming to produce definite reactions, thus differing from McKee's technic. He uses an initial dose of a half or quarter strength plaque screened with .1 mm. aluminum for one to one and a half hours, and for treatment with tubes, a dose of twenty millicurie hours for each tube, screened with .5 mm. silver and 1 mm. rubber, giving this dose to each square centimeter. If no reaction occurs in three weeks, another treatment is given. The most prompt and satisfactory results follow reactions to the point of superficial ulceration.

W. W. WATKINS, M.D.

The Treatment of Keloids with Radium. Laurence R. Taussig. *Calif. St. Jour. of Med.*, XXI, Dec., 1923, p. 520.

Improper use of fluoroscope.—No diagnostic agent is more generally used than the X-ray, and with no other is the profession less familiar. X-ray is both a diagnostic and therapeutic agent. It is a laboratory method for the delineation of gross pathology. Like any laboratory service, the X-ray requires close co-operation between clinician and the laboratory, for the X-ray findings are only a part, although an important part, of the total information required in reaching a correct diagnosis. Improper and superficial use of the fluoroscope, designed as little more than a camouflage, is little short of malpractice. It is difficult for a clinician to bring himself to take the time and pains necessary to prepare his eyes for a proper fluoroscopic examination, and the result is that clinicians attempting to fluoroscope their own patients usually end by making little more than a bluff at it.

W. W. WATKINS, M.D.

The Uses and Limitations of the X-ray. Hugh J. Means. *Ohio St. Med. Jour.*, XIX, Nov., 1923, p. 792.

Gastric jejunal ulcer.—The author believes that there are certain local signs of gastro-jejunal ulcer that are analogous to the ulcer sign in the stomach and duodenum, and that on the basis of

these one is sometimes able to make a precise diagnosis of ulcer.

The author draws attention to the importance of the direct symptoms, the niche and the spasm. The niche in the gastro-enterostomy opening may be difficult to notice when it is so located that the stomach contents pass in front or behind it. It is equally difficult when the ulcer is situated anteriorly or posteriorly in the jejunum. In his experience the indirect signs have not been of any high value, but he does admit the importance of stenosis of the stoma when it is present. In the opinion of the author a gastric residue is frequently present distal to the gastro-enterostomy opening if the latter is placed so as to be disadvantageous to the emptying of the stomach. Gastric peristalsis is generally fairly weak in gastro-enterostomized stomachs, and peristalsis is of sure diagnostic value only when of a steno-otic character.

The author reports five cases of gastro-jejunal ulcer, proved at operation, the roentgenograms of which revealed a niche.

Serial radiography is advised, as the picture of the jejunum varies so much that it is necessary to prove a constant deformity by several plates. In case of an ulcer of the stoma or of the anterior or posterior jejunal wall, it is useful to make a second examination one or two hours after the first, when most of the stomach contents have been evacuated. The patient is then given a second opaque meal in order to demonstrate the location, in relation to the gastro-enterostomy opening and jejunal loops, of any residue remaining from the previous examination and suspected of being a niche.

J. D. CAMP, M.D.

A Contribution to the Roentgen Diagnosis of Ulcus Pepticum Jejun. S. Strom. *Acta Radiologica*, II, 1923, p. 468.

Radium and surgery in tumor cases.—The author quotes Kelley, who said that "he who will give his patients the same consideration he would his wife and sisters will put radium first in the treatment of fibromas."

Neither radium nor irradiation can be used exclusively, if the best interests of the patients are to be served.

(1) Radium is indicated and surgery contraindicated in essential hemorrhage, including fibrosis, hyperplastic endometritis, and any hemorrhage not due to purpura hemorrhagica; in fibromas of any size where complications exist that make surgery extra-hazardous, such as severe anemia, chronic myocarditis, hypertension, obesity, valvular heart lesions.

(2) Cases in which radium or surgery may be used, with radium preferred, include uncom-

plicated cases of fibromas in women over 38, where the tumors are not above medium size (not reaching above the umbilicus).

(3) Cases in which radium or surgery may be used, but surgery preferred, include fibromas in women under 38, provided the operation is a myomectomy; large fibromas reaching above the navel at any age; submucous tumors hanging in the uterine cavity or protruding from the cervix; fibromas complicated by cancer of the uterine body; toxic myoma.

(4) Surgery is indicated and radium contraindicated in degenerating myoma; myoma complicated with other surgical conditions requiring laparotomy, such as appendicitis, ovarian cyst, gallstones; in inflammatory diseases of the adnexa.

Technic is to dilate to No. 11½ Hager, usually without anesthesia, light curettement, and then 25 or 50 mgm. capsule of radium covered with 2 mm. of brass filter and hard rubber shell is introduced. From 900 to 1,200 milligram-hours in women over 38 will produce an amenorrhea and shrink the tumor in 90 per cent of the cases. In younger women 200 to 300 milligram-hours, repeated, if necessary, will regulate menstruation and shrink the tumor.

There may be a watery, sanious discharge for some weeks, which may be thick and have an offensive odor. On the other hand, a severe leucorrhea is often cured by the radium.

W. W. WATKINS, M.D.

Experience with Radium in the Treatment of Certain Fibromas and Metrorrhagias. Monte A. Stern. Journal-Lancet, XLIII, Sept., 1923, p. 466.

Radium treatment for uterine cancer.—

In a series of 885 cases of cancer of the uterus, observed between 1910 and 1919, 70.3 per cent were in the cervix and 29.7 per cent in the uterus. As a rule, cervical cancer is the most malignant, involves adjacent structures early and tends to recur; cancer of the body tends to remain localized, to metastasize late and does not tend to recur. While cancer of the body is attended with better results than cancer of the cervix, the results bear a direct relation to the degree of malignancy based on the cell differentiation described by Broders.

Cancer of the body is usually operable by abdominal hysterectomy. If inoperable, intra-uterine radium is used as a palliative.

The present status of treatment of cancer of the cervix at the Mayo Clinic is as follows: (1) for early cancer confined to the canal, abdominal hysterectomy, or, in the presence of prolapse, vaginal hysterectomy, without preliminary radiation; (2) if entire cervix is involved, radiation is used preliminary to hysterectomy; (3) in

inoperable cases, radium alone is used. All cases that have been subjected to hysterectomy have post-operative radiation and post-operative local recurrences have radium.

It is important that during the first series of radium treatments, all the radium that is ever to be given shall be administered, this amounting to 6,000 or 7,000 milligram hours. It is applied to the cervix, vagina and fundus in doses of 700 milligram hours every two or three days, until the full amount to be given has been administered, usually requiring about three weeks.

All cases treated by hysterectomy receive, post-operatively, three or four treatments of 700 milligram hours in the vagina and deep X-ray exposure over the abdomen and back routinely.

The author says: "It is unlikely that further development of the present accepted methods of treatment of cancer of the uterus, particularly of the cervix, or the institution of new methods, will materially improve the results. The time of application and not the method of treatment is at fault." Better results will come through co-operation in the educational cancer campaign.

W. W. WATKINS, M.D.

Cancer of the Uterus. Verne C. Hunt. Journal-Lancet, XLIII, Nov., 1923, p. 566.

Degrees of malignancy.—Neither surgeon nor radiotherapist should attempt to treat cancer without a thorough knowledge of the behavior of malignant tumor, or a familiarity with the anatomical spread of the disease. Though until we know something definite about the biological laws that cause or are responsible for tissue overgrowth and tumor formation, we shall be at a loss to understand the various phases of malignancy. In one type of carcinoma, the pathological, biological and clinical picture is quite separate and distinct from carcinoma of another group. For example, tumors about the face are almost benign in their behavior in contrast with carcinoma of the tongue, breast or stomach. Similar striking differences are noted in tumors of the cervix and those of the fundus of the uterus.

Similar degrees of malignancy are met with in breast tumors. A mammary tumor may occur as a localized growth, stationary for a long time, or growing very slowly without attempt at metastasis, suddenly flaring up and metastasizing into the neighboring lymph nodes. In a second group, the tumor starts locally in the breast, spreading more or less rapidly in various directions, either by lymphatics into the axillary or supraclavicular regions or by the blood stream to distant parts. In a third group, in which malignant degeneration develops at more than one area in the same breast, the different foci coales-

cing to form one mass. There is an uncommon type in which malignancy develops in both breasts.

The therapeutic indications will vary with the type of tumor. In the first group of purely local tumor without axillary involvement, radical surgery will be effective.

In the second group, with involvement of axillary lymph nodes, surgical results have been disappointing, though surgery alone has shown apparent cures; radiotherapy has also shown some very encouraging results, so that an intelligent combination of the two methods would seem to be a logical method.

The important physical and biological consideration is to administer an efficient uniform dose of radiation to destroy or annihilate all malignant disease throughout. How this is to be accomplished will depend on the personal equation of the radiotherapist. He must inform himself of the exact depth of the lesion from the surface of the skin, and must know in what direction it is likely to spread or disseminate. The dose must be carefully calculated by accurate physical measurements, in order to administer with precision an even and homogeneous radiation to the tumor itself.

Insufficient emphasis has heretofore been laid on maintaining the general constitutional well-being of the patient. The individual with the lesion must be taken into consideration as to his physical state, and his power to react to intensive radiation.

While radiation as we know it to-day is no panacea for cancer, radiation intelligently combined with surgery in the form of pre-operative irradiation followed by radical surgery, and intensive post-operative radiation will effect a favorable result in many so-called hopeless cases.

W. W. WATKINS, M.D.

Cancer of the Breast: Biological Considerations in Radiotherapy. M. J. Sittenfeld. *New York Medical Journal and Medical Record*, Oct. 17, 1923, p. 487.

Diverticula of the stomach.—The scanty statements found in the roentgen literature as to diverticula of the stomach, relate with two exceptions to so-called "functional" diverticula, all of which in the opinion of the author are misinterpreted diverticula of the small intestine situated behind the stomach and originating from the terminal part of the duodenum or from the region of the duodeno-jejunal flexure.

One can distinguish two main groups of diverticula of the stomach, "congenital" and "acquired." The former have a predilection for two places, the cardia and pyloric region. They are most common in the region just behind the cardia. Acquired diverticula are due to many

and various causes and have an extraordinarily varied location. They may result from pressure from foreign bodies; trauma, accidental or operative; tension and traction of circumscribed portions of the stomach.

The author reports a series of five cases of roentgenologically diagnosed organic diverticula of the stomach, observed by him. Four were of the congenital type and localized in the cardiac region and the fifth a case of post-operative diverticulum within the canalis venticuli, verified and removed at operation.

Roentgenologically they are characterized by a rounded shape, varying degrees of filling and distention, soft and mobile contour and the absence of roentgenologic signs of a surrounding infiltrative process. All five cases showed a residue of the barium meal after four hours, and each of the four cases of cardiac diverticulum exhibited, in the erect posture, a gas bubble in the upper portion of the diverticulum.

J. D. CAMP, M.D.

Diverticula of the Stomach from a Roentgenologic Point of View. Ake Akerlund. *Acta Radiologica*, II, 1923, p. 476.

Hour-glass stomach.—The author reports five cases and discusses those types of hour-glass stomach caused chiefly by some intrinsic ulcerative process with a resultant permanent change as: (1) gastric or peptic ulcer; (2) gastric carcinoma; (3) gastric syphilis; (4) tuberculous ulcers.

The clinical signs and symptoms are somewhat indefinite and in most cases are those of peptic ulcer with vomiting. Rarely is the case diagnosed correctly before the roentgenologic examination. The roentgenogram is definitely characteristic and will often demonstrate the etiology.

The treatment is essentially surgical and the best type of surgical intervention can frequently be foretold from the roentgenogram. In considering treatment the cases can be divided into three classes: (1) those in which the point of narrowing is in the lower third; (2) those in which the point of narrowing is in the middle third; and (3) those occurring in the upper third. The treatment consists of gastro-enterostomy, gastro-gastrostomy, or mid-gastric resection according to the location of the constriction and the condition of the patient. As the patients are usually poor surgical risks, the author recommends gastro-gastrostomy for mid-gastric constriction because of its lower mortality.

J. D. CAMP, M.D.

Organic Hour-glass Stomach, with Some Reference to Its Surgical Treatment. H. P. Doub. *Am. Jour. Roentgenol.*, Jan., 1924, p. 67.

Examinations of the genito-urinary tract.—The technic of genito-urinary examination with an opaque solution requires the co-operation of a trained urologist.

Not all examinations of the genito-urinary tract, however, require the use of an opaque solution. Many features of the examination will demand great care and skill on the part of the radiologist. Where there are suspicious shadows, the following must be ruled out: warts, scars, etc., on the body surface; gallstones, calcified glands, calcified costal cartilage, previously injected opaque substance, phleboliths, foreign bodies in the intestinal tract, inspissated pus in tubes.

In cases where there are no suspicious shadows urography becomes the most valuable method of diagnosis.

Cystographs should be made in cases in which the symptoms are those of persistent cystitis with infection. Films should be made in the antero-posterior and lateral positions, as posterior diverticula may sometimes be shown only by lateral views.

The indications for ureterogram or pyelogram are determined by the history of the case. Where there are attacks of intermittent pain in the kidney or ureteral areas, with no evidence of calculus, and cases in which gastric and duodenal ulcer and gall-bladder disease have been ruled out, a careful study of the ureter and kidney pelvis on the affected side should be made for possible intermittent hydronephrosis.

The injection of sodium iodide solution into the genito-urinary tract must be done only by one who is thoroughly familiar with the technic and aware of all the dangers with which it may be fraught.

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Urography. B. H. Nichols. *New York Medical Journal and Medical Record.* Oct. 17, 1923, p. 492.

Conditions in which radiation is indicated.—The conditions in which roentgenotherapy is applicable divide themselves into three groups in accordance with their accessibility; they are the superficial lesions of the skin, the glandular system, and deeper structures.

1. Dermatologic conditions are divided into certain groups in accordance with the nature of the pathology and the change to be effected:

(a) Those conditions in which it is desired to produce a change in the local metabolism of

the cells, the most common conditions in this group being acne, eczema and psoriasis.

(b) Conditions where there is infection of the hair follicles, and epilation is necessary. In this group are included folliculitis, ringworm and sycosis.

(c) Conditions requiring destruction of tissue, such as verruca vulgaris, keloid, lupus, rhinoscleroma.

2. In the glandular group, the spleen and lymphoid structures are very susceptible to radiation, and in most diseases of these structures, radiation is the desirable procedure. The most common splenic conditions are splenomyelogenous leukemia and splenic enlargement, associated with certain anemias including Banti's disease. Permanent cure is not expected in any of these conditions.

Hodgkin's disease offers the strongest indication for radiation, though here also prolongation of life and not cure is the aim.

In tuberculous glands, radiation is the procedure of choice.

In thyroid conditions, where radiation is indicated, the closest co-operation between physician and roentgenologist should be observed.

The tonsil, being a lymphoid structure, naturally calls for consideration in this group; in the author's opinion the roentgen treatment is applicable chiefly to children.

3. Among the deeper structures, the tissue most readily affected is the ovary, and the effect may be graded from a mere diminution of ovarian function to a complete termination of the same.

In uterine fibroids, except in case of pedunculated and intra-uterine fibroids or where there is a single mass which can be removed without disturbing the integrity of the uterus as a whole, surgical treatment of fibroids during the child-bearing period is unwarranted.

It must be remembered that adnexal inflammation contra-indicates radiation treatment of pelvic conditions.

In consideration of the question of carcinoma, there has been a reaction from the so-called "lethal dose" in favor of what is now termed the "optimum dose," in which the systemic reaction does not exceed the patient's tolerance.

When cachexia has appeared, there is practically no hope of a beneficial effect.

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The Newer Aspects of Roentgenotherapy. Charles Eastmond. *New York Medical Journal and Medical Record,* Oct. 17, 1923, p. 484.

